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# THE PRACTICE OF PEDIATRICS

BY

  
CHARLES GILMORE KERLEY

Formerly Professor of Diseases of Children in the New York Polyclinic Medical School and Hospital; Attending Physician to the New York Nursery and Child's Hospital; Consulting Physician to the Babies' Hospital, New York City; Consulting Pediatricist to the Babies' Hospital, Newark, N. J.; Consulting Pediatricist to the Fifth Avenue Hospital, New York; Consulting Pediatricist to the Greenwich (Conn.) Hospital, to the Tarrytown (N. Y.) Hospital, to the Englewood (N. J.) Hospital, and to the Lawrence (Bronxville) Hospital; Ex-President American Pediatric Society; Ex-President New York County Medical Society

AND

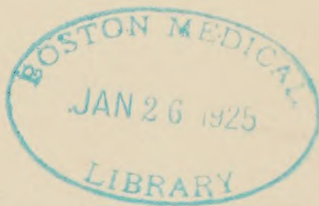
GAYLORD WILLIS GRAVES

Associate in Diseases of Children in the College of Physicians and Surgeons (Columbia University); Adjunct Assistant Visiting Physician and Physician to Out-Patients, the Children's Medical Service of Bellevue Hospital; Attending Physician to the Seaside Hospital of St. John's Guild, New York

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## PREFACE TO THE THIRD EDITION

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THIS edition has been prepared with the assistance of my former associate, Dr. Gaylord Willis Graves, who will hereafter be connected with the work as co-author.

The book has been largely rewritten, with the addition of much new material both in the form of text and illustrations. In particular the additions comprise consideration of the following subjects: Growth and Development, Methods of Infant Feeding, Developmental Gastro-intestinal Abnormalities as Shown by *x*-Ray, Scurvy, Rickets, Asthma, Pneumonia, Influenza, Endocrine Disorders, Nephritis, Tetany, Hydrocephalus, Epidemic Meningitis, Encephalitis Lethargica, Smallpox, Measles, Diphtheria, Scarlet Fever, Acidosis and Alkalosis, Diabetes Mellitus, Acrodynia, Defective Bodily Mechanics, Foreign Bodies, Diagnostic Methods, and Special Therapeutic Procedures.

A number of the older articles and illustrations have been omitted as no longer essential.

With the incorporation of new material the foot-note references have been greatly supplemented.

The authors desire to express their indebtedness to Dr. Howard Reid Craig for valued assistance in the preparation of the work, and to acknowledge helpful courtesies from the staff of the Children's Medical Division of Bellevue Hospital.

CHARLES GILMORE KERLEY.

NEW YORK CITY,  
*October, 1924.*



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# The Practice of Pediatrics

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## I. NUTRITION—GROWTH—DEVELOPMENT

### NUTRITION AND GROWTH

THE fundamental principles in the life of the young of all animals are growth and development. This statement applies to the young of the lower animals as well as to man. Nature has fixed and definite laws in accordance with which this growth and development proceed. The type of animal produced depends in no small degree upon the way in which we comply with these laws.

**Heredity.**—Inheritance is, of course, an important factor, but environment counts for more. The young of the lower animals or of man may possess all that can be desired in the way of heredity, but if management during growth is faulty, the adult is almost certain to fall short of the normal. On the other hand, an individual without the benefits of good heredity, when given the advantages of faithful scientific care may develop into an adult decidedly superior in all respects to those more fortunate in birth.

**Environment.**—One who carefully watches the growth and development of animals will observe that under care as to feeding, housing, ventilation, cleanliness, and exercise, those which promise but little at birth develop into perfect specimens of their kind. Similarly, prolonged intimate association with thousands of infants and growing children in private, in hospital, and in out-patient work inevitably impresses upon a physician the possibilities of growth under good management even when little has been expected, judging from the original condition of the patient.

The child is here through no choice of his own. He is to have a future. Because his health, vigor, powers of resistance, happiness, and usefulness as a citizen are determined in no small degree by the nature of his care during the first fifteen years of life, he has a right to demand that such care be given him as will be conducive at least to a sound, well-developed body, and this should be our first thought and object regarding him. Consider for a moment the number of occupations, other than those of the army and the navy, that require physical fitness before a candidate is accepted. Competition is keen at the present time and will be keener in the future. Employers of men and women, whether in the office, the factory, or on the farm, cannot afford to utilize the physically weak.

**Care and Feeding.**—The most important physical factor in the making of men and women is nutrition. No great power of reasoning is required to appreciate the fact that the child who is fed on suitable food will become

a more vigorous, better developed adult than one who, beginning at birth and continuing throughout the entire period of growth, is given only food possessing indifferent qualities for tissue building. Next in importance to food, and following in close correlation, are fresh air, cleanliness, cheerful surroundings, and healthful amusements, together with an absence of school work or service of an arduous nature. That the offspring of man suffers more from nutritional errors due to the lack of suitable care than do the young of the lower animals is lamentable, but nevertheless a fact. The absence of thought and care and of knowledge relating to children is due to the fact that the child as such has apparently no intrinsic value in dollars and cents, whereas the young of the lower animals represent no small part of their owner's material possessions. Another factor having a deterrent influence upon the development of children is their unfavorable start during the first year.

Positive success in the management demands daily attention to detail. Feeding the child properly one or two months out of the year is of little value. He should be fed properly every day in the year, for under normal conditions every day is a day of growth. Unfortunately, many mothers cannot supply to the infant the requisite nourishment. This brings us to the matter of substitute feeding, fraught with perplexities and uncertainties in the most competent hands, and with dangers and disasters in the hands of the incompetent and inefficient. In the section on Artificial Feeding of infants their nutrition is considered in detail. It is sufficient to remark here that nature has provided for the baby a food which contains the nutritional elements, fat, sugar, and protein, in fairly definite proportions and in peculiar forms. Success in substitute feeding depends upon our ability to supply in suitable forms, and the child's ability to assimilate, a food containing the nutritive elements in approximately the quantities found in human milk. An exact reproduction of mother's milk by the use of cow's milk or other food is, of course, impossible. We can imitate human milk, however, with sufficient accuracy to make acceptable and sufficient food for most children who are deprived of the breast. After the nursing or the bottle age the feeding must not be left to the family judgment, for at this period of rapid growth suitable nutrition is most important. Left to the family, the diet during the second year too frequently consists of milk, which in large cities is often of uncertain nutritive value, together with insufficiently cooked cereals, boxed breakfast foods, bread-stuffs, crackers, and cake—often procured at the grocer's or baker's. At the Out-patient Departments of the New York Babies' Hospital and the New York Polyclinic Medical School only 20 per cent. of a large group of the children treated who were over one year of age were found to be of normal development. In those under one year of age only 35 per cent. were normal. While these groups are not to be considered as representing the country as a whole, still they do represent a large part of the population of our larger cities, the offspring of day-laborers, drivers, waiters, and small-wage earners generally. Such children were fed in the manner above described, not because of poverty, but because of an absence of the slightest knowledge on the part of the parents regarding suitability of foods. The children were not hungry, and were fed to satisfy taste

rather than true appetite; when that was accomplished the parents considered their duty done. To feed with a definite purpose—with a view solely to the physical development of their children—had never entered the minds of the parents, yet most of them could read and write and possessed a fair degree of general intelligence. They were conversant with affairs and had attended the public schools, but were absolutely untaught as to how they should live.

### FOOD PROPERTIES AND PHYSIOLOGIC REQUIREMENTS

Substances used as foods, regardless of the animal which they may nourish, possess the common property of being composed of fat, protein, carbohydrate, mineral substances, and water in varying proportions. The purposes that these serve in the animal economy are essentially the same in all forms of animal life. In order to determine the food value of any substance a chemical analysis which shows the quantities of these nutritional elements is required. It will be found that foods varying widely in appearance and physical properties are still similar in that they are composed of the same food elements, although in different proportions.

Foods used to sustain animal life of any kind must contain the ingredients needed by all animals, and in a form suited to the particular kind of animal to be fed, whether it is man or one of the lower animals.

**The Ingredients of Foods.**—While all foods are composed of fat, carbohydrate, protein, mineral substance, and water, these elements exist in widely differing forms. Fat may be supplied in meat, egg, milk, butter, oleomargarine or butterine, lard, olive oil, cod-liver oil, linseed oil, cottonseed oil, etc. Carbohydrates may be furnished in the form of cane-sugar, milk-sugar, maltose and dextrose, soluble products derived from starch, cornstarch, wheat or other flour, oatmeal, rice, hominy, bread, potatoes, etc. Proteins are secured in the form of lean beef, lamb or pork, chicken, fish, the gluten of such cereals as wheat and oats, in large quantities from peas, beans, lentils, and other legumes, from the curd of milk, and also from eggs. The mineral substances of food are found combined with the other ingredients in the form of lime, phosphates, magnesium, iron, etc.

**The Function of the Food Elements.**—The proteins of the food are used to form the bodily structures and to replace tissue consumed by the vital processes and excreted as urea. The vital processes, such as the circulation of the blood, respiration, and contractions of the muscles, call for energy, and this together with bodily heat must be supplied by the fats and carbohydrates. The mineral substances are used in the formation of bone and teeth, while the water serves to dissolve the food elements after they have been digested and to carry off waste products.

As the demands made are variable and directly dependent upon numerous changing conditions both within and without the body, food must be varied in amount and character to meet the altering demands. Exercise, variations in external temperature, lowered digestive capacity, illness accompanied by fever, growth, and repair all have to be considered apart from the conditions attendant upon the so-called basal metabolism of the resting organism. Thus meat, with its abundance of protein, serves as the chief food of the laborer expending muscular energy, fat

serves as the reserve store of the Eskimo, and carbohydrate, by reason of its easy digestibility and ready availability as fuel to spare tissue waste, is of great value in disease states associated with fever.

When one thus considers food in the light of its component elements more detailed knowledge is seen to be essential to any mastery of the subject of nutrition of the growing body.

*Proteins.*—These are commonly called nitrogenous foods because of the characteristic presence of nitrogen in the complex protein molecule. The nitrogen component makes the protein element in food invaluable for tissue growth and repair, while the carbon available in protein supplies heat and energy. Protein is thus the one complete food, but it has the disadvantages of being less concentrated in caloric value and less stable under the influence of physical and chemical agencies, including bacterial action, than many forms of carbohydrate and fat, while the difficulty of absorption and elimination of some forms of protein has also to be reckoned with in the problem of diet. Not to be forgotten is the fact that the most expensive foods are usually those high in protein, and that protein susceptibility or anaphylaxis exceptionally constitutes a contraindication to the use of certain foods by certain individuals.

Of the numerous amino-acids into which the protein foods are eventually broken down in the digestive canal, lysin, cystin, and tryptophan are of greatest value for growth.

*Fat.*—For purposes of nutrition, fat is of value as a protein sparer of very high caloric value. In spite of its relatively slow digestibility it is largely absorbed, and besides serving as a fuel of slow combustion is readily stored up. The unoxidized intermediate products of fat metabolism may lead to acidosis, particularly if there is not enough available carbohydrate to "make fire" for their complete oxidation.

Calcium and other mineral substances are ordinarily stored more readily in the body when the fat intake is adequate. This is illustrated by the rapid lowering of calcium excretion in rachitic subjects when cod-liver oil is added to a previously deficient diet.

*Carbohydrates.*—These not only serve as protein spacers, but are immediately available for combustion. When stored as glycogen, carbohydrates may be transformed into fat.

Of the two chief forms of carbohydrate, the sugars and starches, the former are absorbed most readily, but by reason of their ready fermentability not infrequently contribute to vomiting and diarrhea. To safeguard against this possibility we employ mixtures of starch and sugar in order that absorption may take place at more than one level in the digestive tract, thus entailing less risk of fermentation than would exist if the stomach were required to do all the work.

Starch after being converted into dextrin and then maltose eventually breaks down into two molecules of dextrose; cane-sugar is split into dextrose and levulose, and lactose into dextrose and galactose.

The argument as to what is the best form of carbohydrate to administer in a given case always evokes controversy, but in general one has only to remember the following facts:

Lactose, the natural milk sugar, ferments more readily in the intestine than in the stomach and is more slowly absorbed than maltose.

Cane-sugar has the great advantage of cheapness and availability.

Maltose is readily absorbed, but not infrequently conduces to gastric fermentation.

Dextrin derived from starch has a protective colloid action, and undergoing slow change to maltose does not readily contribute to sugar excretion in the intestine.

This subject will receive further consideration under the discussion of Artificial Feeding of infants, p. 69.

*The Mineral Substances.*—A discussion under this heading leads one immediately into the chemistry of bodily structure as well as that of function, and the problem involved belongs to a special sphere of medicine.

We may remind ourselves, however, that in milk we have relatively large amounts of the calcium, phosphorus, and magnesium salts necessary for bone development, whereas we are confronted with a lack of iron so essential to the blood.

At an early age the requirements of the infant must therefore be met by the use of supplementary foods, particularly iron containing vegetables, meat juice, and egg.

*Vitamins.*—A definition of these substances may hardly be made specific. In general, vitamins are accessory elements in raw foods, of little or no caloric value, but of vital importance even in minute quantities to the maintenance of health and nutrition.

Vitamin A, or the fat-soluble vitamin, is found in cream, egg yolk, and cod-liver oil, but is lacking in vegetable oils. It is not appreciably affected by heat. Vitamin A has been called the antirachitic vitamin because of the demonstrable value of the substances which contain it, particularly cod-liver oil, in the prevention and cure of rickets. Whether the term "vitamin" really belongs to the "antirachitic principle" in the cod-liver oil remains to be proved.

Vitamin B, a water-soluble vitamin, occurs in yeast, husks of grains, milk sugar, and a large range of vegetable foods. It is affected, but not rendered inadequate by heat. By reason of its preventive and curative value in polyneuritis and beriberi vitamin B is called antineuritic.

Vitamin C, water soluble, is found in fruit and vegetable juices, particularly oranges, lemons, tomatoes, and potatoes. It is present also in small amount in raw milk. This vitamin is destroyed by heat. Its absence for a long period from the diet may lead to the development of scurvy. For this condition, moreover, it is specifically curative, consequently bearing the name antiscorbutic vitamin.

*Water*, the remaining food constituent, comprises about 87 per cent. of milk and is present in large amounts in a wide variety of natural foods. In health its importance is not likely to be forgotten. Nevertheless, wrong notions on the part of the laity sometimes preclude adequate fluid intake in illness. For the digestion of food, the radiation of heat, the dilution of toxins in the circulation, and the proper functioning of the bowel and kidneys the administration of water by at least some avenue of entrance to the body must always be maintained.

**The Advantage of a Knowledge of the Composition of Foods.**—Inasmuch as each food element has a special function to perform, and

since growth is impossible without a sufficient supply of these nutritional elements, particularly the protein, it is essential to know within reasonable limits the composition of a food, because if the elements are not present in proper proportions, disappointing results may be obtained from its use. Difficulty which may appear inexplicable will readily be accounted for if we know what element of the food is at fault. For these reasons it is coming to be the practice, in infant feeding especially, to speak of the percentage composition of the milk foods, as, for example, a food containing 4 per cent. fat, 7 per cent. carbohydrate, 2 per cent. protein, and 0.35 per cent. mineral substances. Knowing from wide experience the percentages of these ingredients generally needed in a food if it is properly to nourish a child, the physician can determine in an instant whether an infant is having a food of suitable nutritive value by comparing its known composition with that established, by experiment, as requisite.

**Values of Common Foods.**—The following table shows the average chemical composition of a few of the more common American foods<sup>1</sup>:

Food material.	Water, per cent.	Protein, per cent.	Fat, per cent.	Carbohy- drate, per cent.	Calories per 100 gm.
Cooked:					
Roast beef.....	48.2	22.3	28.6	....	357
Round steak (fat removed as pur- chased).....	63	27.6	7.7	....	185
Tenderloin, broiled.....	54.8	23.5	20.4	....	287
Beef juice.....	93	4.9	0.6	....	25
Lamb chops, broiled.....	47.6	21.7	29.9	....	367
Lamb, leg, roast.....	67.1	19.7	12.7	....	198
Mutton, leg, roast.....	50.9	25.0	22.6	....	313
Ham, smoked, broiled as purchased....	51.3	20.2	22.4	....	291
Bacon, smoked.....	20.2	10.5	64.8	....	646
Chicken, broiler.....	69.7	20.7	8.3	....	196
Codfish, fresh, whole.....	82.6	16.5	6.4	1.2	103
Salmon, whole.....	64.6	22	12.8	1.4	209
Egg, boiled, 1 egg (50 gm.).....	36.6	6.5	6.0	....	169
			(Total, 1 egg		83)
Butter.....	11	1.0	85.0	....	795
Milk, whole.....	87	3.3	4.0	5.0	72
Oatmeal, boiled.....	84.5	2.8	0.5	11.5	63
Rice, boiled.....	72.5	2.8	0.1	24.4	112
Bread, wheat.....	36.7	7.9	4.8	49.7	281
String beans, cooked.....	95.3	0.8	1.1	1.9	21
Peas, green, cooked as purchased....	73.8	6.7	3.4	14.6	119
Potatoes, boiled.....	75.5	2.5	0.1	20.9	97
Spinach, cooked as purchased.....	89.8	2.1	4.1	2.6	57
Apples, edible portion.....	84.6	0.4	0.5	14.2	64
Bananas, edible portion.....	75.3	1.3	0.6	22	101
Oranges, edible portion.....	86.9	0.8	0.2	11.6	53

#### Calculation of Caloric Values from Food Composition Percentages.—

In order to calculate the approximate quantity of heat energy available to the body from a given food we assume the physiologic fuel values as 4.1 calories per gram for carbohydrate, 9.3 calories per gram for fat, and 4.1 per gram for protein.<sup>2</sup>

<sup>1</sup> Nutrition and Clinical Dietetics, Carter, Howe, Mason.

<sup>2</sup> Ibid.

**The One Hundred Calorie Portion.**—For rough computation one may base estimates on the 100 calorie portion into which many articles of food naturally fall.<sup>1</sup>

Examples of food portions containing about 100 calories are as follows:

Milk.....	5 ounces
Meat.....	2 ounces (1 chop)
Fish.....	3 ounces
Bread.....	1 slice (3 x 3 x 1 inch)
Potato.....	1 medium
Sugar.....	2 tablespoonfuls
Apple, orange.....	1 of good size
Egg.....	1½

**Caloric Requirements.**—The actual requirement in calories per diem depends on many factors, not the least important of which is the age of the individual whose needs are to be met. During infancy the caloric requirement usually accepted is 100 per kilogram or 45 calories per pound of body weight. During the first few weeks of life the requirement ranges from 25 to 35 calories per pound of body weight.

The following table gives the calories per day required by children of different ages, as estimated by Miss Gillett.<sup>2</sup>

FOOD ALLOWANCES FOR CHILDREN (GILLETT)

Age, years.	Calories per day:	
	Boys.	Girls.
Under 2.....	900-1200	900-1200
2- 3.....	1000-1300	980-1280
3- 4.....	1100-1400	1060-1360
4- 5.....	1200-1500	1140-1440
5- 6.....	1300-1600	1220-1520
6- 7.....	1400-1700	1300-1600
7- 8.....	1500-1800	1380-1680
8- 9.....	1600-1900	1460-1760
9-10.....	1700-2000	1550-1850
10-11.....	1900-2200	1650-1950
11-12.....	2100-2400	1750-2050
12-13.....	2300-2700	1850-2150
13-14.....	2500-2900	1950-2250
14-15.....	2600-3100	2050-2350
15-16.....	2700-3300	2150-2450
16-17.....	2700-3400	2250-2550

The basal requirements as determined by Benedict and Talbot are highest at about nine months and thereafter steadily diminish.

Holt and Fales<sup>3</sup> found that the average for three of the component factors which go to make up the total requirements (*i. e.*, basal metabolism, growth, and excretion) is nearly uniform for children of the same weight under similar living conditions, but that the requirement for activity

<sup>1</sup> Vide Fisher's Table of One Hundred Calorie Portions, Jour. Amer. Med. Assoc., 1907, xlviii, 1320.

<sup>2</sup> Food Allowances for Healthy Children, Pub. 115, New York Assoc. for Improving the Conditions of the Poor, 1917.

<sup>3</sup> Amer. Jour. Dis. Child., January, 1921.

varies markedly. According to these writers the following is the average caloric requirement for children:

At one year, 100 calories per kilo.

At six years (for children weighing 20 kilos), 80 calories for boys, 76 calories for girls.

At ten to fifteen years, 80 calories for both sexes.

After fifteen years for those weighing at least 50 kilos, about 48 calories.

These investigations confirmed Benedict's statement that a most liberal diet is desirable for children, since evidence indicates that children receive too little rather than too much food.

**The Value of Caloric Feeding.**—The caloric standard in its application to infant feeding is further considered in a later section (p. 67). The method has been severely criticized and there is little doubt that its value is greater as a check than as a guide for the dietitian. Computations based upon weight alone are misleading and are being replaced by those which take into account the relation between body surface and basal metabolism. Upon this subject the work of DuBois, Benedict, Harris, Gephart, and others has been in the front rank.

**The Feeding Method of the Von Pirquet School.**—This method was a direct outgrowth of needs existing in Vienna as a result of the World War. The founder concluded that the square surface of the intestinal canal was the best measure of the amount of food one required as a daily allowance, and he estimated this surface as equal to the square of the individual's sitting height. He further coined the word "nem" ("nährungs einheit milch," nutritional unit milk) to express the value in energy of 1 gram of mother's milk.

This was selected as the basic food in terms of which all diets were calculated with due allowance for the factors of age, activity, and illness.

In the feeding of large numbers this ingenious method as applied abroad proved of great value. The system, however, has as yet not been generally adopted in this country, and whether the "nem" will replace the calorie in our computations remains to be proved.

**The Selection of Food.**—In a review of analyses of foods many substances will be noticed which, according to their chemical composition, have the same food value, but which obviously are not interchangeable. For instance, no one would attempt to feed to a human being cracked oats unless thoroughly cooked, but he would give them raw to the lower animals. Oats will nourish a man or the animal equally well, but for man they must be prepared, while the horse, for example, can utilize them in their original state. This illustrates the importance of *adapting food* to the consumer. Often the question in feeding is not so much, Is the food nutritious? as, Can the patient assimilate it? Thus, success in infant feeding lies in the physician's ability to discover a form of fat, carbohydrate, and protein which the infant can assimilate. In the following pages feeding measures for temporary use will be described which may not conform to what may seem strictly scientific principle, yet often give brilliant results. Looking a little below the surface one will discover that the measures suggested are not unscientific, and that the results are due to applying the fixed principles of nutrition in perhaps novel or unusual

ways. It is usually best to follow the most direct route to any place, but when this is badly blocked it is better to go another way, if there is one, rather than not to arrive at one's destination.

**General Properties of Milks.**—When most young animals are born their digestive organs are in a more or less embryonic condition, and it is several months before they entirely outgrow this state. During this period the nourishment is supplied by the mother through her mammary glands, first as colostrum and later as milk. When these secretions are analyzed they are found to consist of fat, carbohydrate, protein, mineral substances, and water, and in this respect they do not differ from other foods. But the elements exist in the secretion in peculiar forms, and the natural inference is that in some way this food must be particularly suited to animals whose digestive organs are still undeveloped.

The digestive secretions of the stomachs of all known animals contain pepsin and hydrochloric acid. In the very young these secretions are feeble, but as development proceeds they are much more abundant. To understand milk as a food one must know the effect upon it of pepsin and acid. When pepsin is added to tepid cow's milk it causes the milk to solidify, with the formation of curd or junket. If the milk is slightly acidified or soured, the curd formed is dense and solid and more difficult of digestion. When the milk of the cow, of the ass, and human milk are separately treated with pepsin and acid in exactly the same way, curds totally different are formed, and as the human digestive organs are different from those of the cow or the ass, it is believed that these differences in the digestive properties of milks are for the purpose of making the milks suitable for the different kinds of digestive tracts. Milks may be regarded as special forms of food which require greater digestive effort as the digestive secretions of the stomach become stronger, and thus solid food is furnished to the developing stomach. It is that portion of the protein of the milk called "casein" that is changed into a solid by the pepsin of the stomach. The term "casein," however, has been loosely applied to all the proteins of all milks. The caseins of all milks are not alike in their digestive properties and the mistake of so considering them should be guarded against. A consideration of such a modification and adaptation of cow's milk as will make not only the protein but the other ingredients acceptable to the infant's digestive capacity will be found in the chapters dealing with Substitute Feeding.

## AIDS TO NUTRITION

**Fresh Air.**—Doubtless the next most important factor after food and the means of giving it is good air. It is a just criticism of the average American that he is afraid of fresh air not only by night but by day. Ventilation is one of the most difficult features of a child's management with which the physician has to deal. Mothers will feed the children in detail according to instruction and will bathe them and follow out to our satisfaction every order and direction. The stumbling-block is the open window. It is to be hoped that a knowledge of the means and results of treating tuberculosis by open-air methods, and the recent agitation concerning the treatment of pneumonia and other infectious diseases

along similar lines, may so permeate the minds of the masses as to quiet their fears regarding dangers of outdoor air.

While the child is out of the living-room or nursery the room should be ventilated by opening all the windows, when family conditions allow, the nursery always being aired in this way. The sleeping-room should always be aired for one hour before the child is put to bed. Indoor airing for which the child is dressed as for going out, placed in his carriage or cart, and wheeled up and down the room for an hour or two with the windows wide open regardless of the weather, is most satisfactory in treating very young and delicate children, and promoting convalescence from illness. On inclement days the well child accustomed to his daily outing will be greatly benefited by the indoor airing. It is fully appreciated that such a course of management is impossible in many households. The scheme is the ideal one, however, and should be followed out as closely as possible.

*The Window-board.*—A convenient and simple means for ventilating the living-room, sleeping-room, or sick-room of a child in cold weather is what is known as the window-board. A plain inch board is sawed the width of the window-frame and placed under the raised window in the lateral frame groove, resting upon the sill. This raises the top of the lower sash above the bottom of the upper one, leaving a space between through which the air enters with the current directed upward. The board may be of any width—4, 6, or 8 inches. A width of 6 inches is commonly used. There are various ventilating devices in the market. Those that are of value are expensive, and their effectiveness over the simple means above suggested does not always warrant the expenditure.

**Sunlight.**—Long before Rollier, who has been called the High Priest of Modern Sun Worshipers, opened his first clinic at Leysin in 1903, the value of sunlight had been appreciated. As heliotherapy is developed more highly and the relative value of the different component rays of the spectrum is being accurately determined, knowledge that had been only empirical is being established as scientific truth. "Who would have guessed," wrote Saleeby,<sup>1</sup> "that a few minutes' exposure to sunlight will double the quantity of phosphorus in a baby's blood in a fortnight."

Dick, writing of the geographic distribution of rickets, has shown a direct relationship between its incidence and the amount of sunlight available to the inhabitants of a country. Recently the fact that sunlight which traverses window glass is deprived of its actinic rays and is no longer appreciably curative has been established.

In detail the effects of sunlight are to promote a rise in body temperature, surface pigmentation, better nutrition of skin and muscles, and increased reaction against disease foci, such as those of tuberculosis. Various skin diseases, tuberculosis, rickets, arthritis, lymphatic gland diseases, and even leukemia have all been benefited by the solar rays.

To the growing child *outdoor* sunlight is a first essential.

**Suitable Clothing.**—If this problem were submitted to the best exponents of heliotherapy, the answer would be no clothing; for their work has shown conclusively that the body is soon inured to temperature

<sup>1</sup> Rollier, *Heliotherapy*, 1923, p. 17.

changes, and even when undergoing the depletion of actual disease, such as tuberculosis, may show most rapid recuperation if the surface is completely exposed to light and air. Practically, however, the overheated modern apartment, on the one hand, and the slush-filled, wind-exposed street on the other, make for a situation that must be met by individual care. Particularly in the case of the delicate child proper clothing thus becomes a chief aid to nutrition.

A mixture of silk and wool or linen mesh next the skin is uniformly desirable. For the infant the circular abdominal band is a physiologic asset, and this may well be worn until after the completion of the first year even when other clothing is very light, particularly if there is a tendency to gastro-enteritis, which is readily aggravated by chilling of the surface. Outer clothing rather than the underclothing should be varied to meet weather changes and should insure at all times warm hands and feet. Further than this one needs not to advise, particularly when every nursery is flooded with literature concerning the details of the baby's and child's habiliments.

For a baby on very hot days a napkin, a muslin slip, and a band comprise complete equipment.

**Bathing.**—The necessity for the daily bath is appreciated and acted upon by nearly all classes of society. From the time the cord falls and the cicatrix forms, the well infant or child should have one tub-bath daily. If he is too ill for the tub, he is not too ill to be sponged.

**Relaxation.**—The well child is naturally good natured and happy. When such is not the condition, we have not a well child to deal with. Something is wrong. Perhaps it is the home management. Adults often forget that exuberance of spirits and thoughtlessness belong to childhood. Persistent child nagging becomes a habit with many parents and teachers; in fact, irritable mothers usually have irritable children. Work involving strain, whether physical or mental, should form no part of the life of the child. In our modern school system the forcing process, the competitions, and the giving of rewards of merit are all pernicious practices. As a result of the competitive system, progress, to be sure, is made along intellectual lines, but at the expense of the physical; and what does intellectual attainment count for in a weakly or diseased body? A child cannot do hard mental work, such as is required of many children from the tenth to the fifteenth year, and be expected at the same time to develop to the best advantage physically. The appetite and digestive power, the capacity for taking and assimilating food, is diminished. The result is apparent in hundreds of cases. On the streets in New York two pictures always fill us with pity. One is that of the pale, slender school-girl struggling home with a load of books. (Such a child had 11 text-book studies besides piano and dancing lessons!) When the question is asked the child or the parents as to the necessity for all this work and worry and the close confinement which it entails, the reply almost invariably is that all the girls of her age do the same and she does not want to be behind. The other picture is that of the "little mother"—a pale, wan, tired child from seven to twelve years of age who "minds the baby" and the other younger members of the household while their mother is away from home or at work. Children so abused are happily growing fewer, owing

to various factors which need not be discussed. It is needless to say that neither type of girl makes the ideal woman or mother in any station in life. The condition of boys who work in factories, sweat-shops, or elsewhere is no better. When too much energy is expended in work, food cannot go to the building up of a strong, normal body. The State is the loser and the child is robbed of his birthright.

It is the duty of physicians to explain in detail to parents their responsibility as regards the physical welfare of their children. Parents, as a rule, are ignorant concerning a child's management; but they are anxious and willing to do the best things possible, and will carry out suggestions if we take the trouble to enlighten them as to their errors.

**Sleep.**—The infant who sleeps well is almost always a normal, well-fed baby. Irritability and sleeplessness are associated with indigestion more frequently than with any other disorder. During the first few days of life the sleep, in normal conditions, is almost unbroken, except when the infant is fed. During the first month the infant sleeps about twenty-two hours out of every twenty-four; during the second and third months, from twenty to twenty-two hours. At the sixth month the child should sleep from 6 P. M. to 6 A. M. without interruption except for feeding or nursing, which need cause very little disturbance. At this age there should be a two-hour nap during the morning and a two-hour nap in the afternoon, although it is not well to have the baby sleep after 3 o'clock in the afternoon. The twelve-hour night rest should be continued until the child is six years of age. The day naps will gradually be shortened by the child. At one year of age one hour in the morning and two hours in the afternoon suffice. From the eighteenth month to the second year the morning nap may be given up. Afternoon rest for at least one and one-half hours should be continued until the sixth year of age, and longer if the child is inclined to be delicate. Regular sleep is largely a matter of habit, and if the infant is started right with suitable feedings given at definite times, followed by the proper period of sleep, little trouble will be experienced. When sleep is disturbed and broken the condition means bad habits, unsuitable food, minor forms of indigestion, or positive illness of some kind. Sleep is important for purposes of growth, not only in early infancy but throughout childhood. Not a few infants form habits of sleeping in the daytime and being wakeful at night. This is best remedied by keeping the baby awake during the day by entertainment and by keeping him in a well-lighted room. A proper amount of sleep is most essential to nutrition, and we are sure that the satisfactory results achieved in the treatment of secondary malnutrition and anemia have been due in part to insistence that the child sleep in a quiet, darkened room for two hours after the noon-day meal. The energy expended in twelve hours by an active child is incalculable, and when a portion of this energy is reserved and the body fortified by rest and sleep during the middle of the day, there is a greatly diminished daily expenditure of strength units.

**Crying as Exercise.**—Notwithstanding the desirability of sufficient sleep it is well for the young infant to cry a little every day. Muscular movements involving a greater part of the body accompany the act of crying and furnish exercise. Peristalsis is increased, as is often evi-

denced by a movement of the bowels occurring during crying, particularly when there is diarrhea. In crying, deep breathing is necessary, the lungs are expanded, and the blood oxygenated. In this respect crying itself is an aid to growth and development. The well baby cries when frightened, or uncomfortable from hunger, soiled napkins, or irritated buttocks. He cries from pain, from heat, from cold, from unsuitable clothing, and during difficult evacuation of the bowels. He also cries when displeased or angry.

Authors are prone to refer to the diagnostic value of an infant's cry. It is probable that characteristic cries are not to be depended upon sufficiently to give them a differential diagnostic dignity. Children slightly but painfully ill may cry incessantly for an hour or two. Thus, with intestinal colic, the cry is loud and continuous until the child is relieved or falls asleep from exhaustion. Earache is not an infrequent cause. The habitual criers, the restless and vigorous, crying, whining infants, are uncomfortable. With very few exceptions the trouble will be found in the intestinal tract. The well-trained, normal child, whose nourishment is suitable, is seldom troublesome. When well, all babies are naturally good natured and happy in their own way. Badly managed, spoiled infants often cry vigorously when left alone. When attention is given them, when they are taken up and talked to, the crying ceases. This readily tells us that pain or discomfort was not an element in causing the cry. By these infants discipline, not medication, is needed. The management of the habitual crier calls for the relief of the condition which causes the discomfort, or the most rigid discipline, when it is demonstrated that we are dealing with a "spoiled infant."

**The Nursery Maid.**—In certain stations and conditions of society the young child is cared for by the mother with the assistance of the immediate members of the family. In thousands of homes, however, a helper is employed to take charge of the child or assist in the care. The selection of a nursery maid is consequently a matter of much importance. Schools for training nursery maids exist in New York, Boston, Albany, Newark (New Jersey), and doubtless in many other cities. Although such trained help is greatly to be desired, the supply is very limited. Some of the best children's attendants have been women who, although they have not passed the meridian of life, still have reached the seasoned age when the attractive qualities of policemen and grocery boys have faded into a dim recollection. Any industrious, sensible young woman of quiet tastes who is fond of children can be trained in a few weeks into a most useful helper. The association of the nursery maid and child is a close one, and it is the physician's duty to know that the applicant is physically fit for the position.

During a single year the senior writer has known of three nursery maids who developed pulmonary tuberculosis while in service. Numerous similar instances have been cited by other observers.<sup>1</sup> Not only should the applicant's lungs be examined but also the mouth, nose, and throat. Carious teeth and diseased conditions of the throat and nose should receive careful attention before the maid is allowed to assume the position.

<sup>1</sup> *Healthy Servants Only in a Healthy Home*, by Charles Hendee Smith, M. D., Bulletin of New York Tuberculosis Association, vol. iii, No. 4.

It is also important that something of the applicant's previous life should be known.

One of the most important things to know about an applicant in a large city, and one most difficult for the physician to discover, is the existence of leukorrhea, or vaginal discharge.<sup>1</sup> This, however, can usually be discovered by the tactful young mother. Not only should the ideal nursery maid be physically fit, she must be mentally fit as well. For proper mental and physical development children must be entertained and pleasantly employed. An ill-natured, impatient nurse should be forced to seek other employment. It should not be a task for a child's attendant to play with him. A woman should not be condemned, however, because she fails with any given child. With a child differently situated, with a different temperament, the results may be perfectly satisfactory.

**The Nursery.**—This should be the largest and best ventilated room in the house. In a city home the room may well be located on the third or fourth floor, with a southern exposure. In apartments, quiet, and the possibility of free ventilation and sunlight must be considered in selecting the room. For the sake of quiet the nursery should not communicate with the sleeping-rooms of older children.

In placing children in sleeping-rooms or in a nursery, or in estimating the capacity of hospital wards for children, it is to be remembered that at least 1000 cubic feet of air space should be allowed to each child.

The floor of the nursery should not be carpeted. A hardwood floor is best. If this is not possible, covering the floor with oil-cloth or linoleum is always possible. This can be cleaned with a damp cloth every day. A broom should never be used in a nursery. Paint or hard finish on the walls is preferable to paper. There should be at least two windows and an open fireplace. If possible, the bath-room should be connected with the nursery, to be used not only for bathing the child but as a "changing room." The child's napkins should not be changed in a living-room if it can be avoided. It is needless to say that napkins should never be dried in the nursery.

Steam heat as ordinarily used today is the least desirable means of heating on account of its uncertainty. In many New York apartments of the better class the fires are banked at 10 P. M.; the temperature when the child retires is from 70° to 80° F. or more; by 5 or 6 o'clock in the morning a fall to 50° or 60° F. has taken place. Such a change in the temperature, with the tendency of children to kick off the bedclothes, explains many cases of tonsillitis and bronchitis. The temperature of the nursery should be kept as even as possible. When for any reason this cannot be controlled, it is best to have two means of heating, so that when one fails the other may be used. The open-grate fire or a small wood-stove is best. Gas should never be employed as a means of heating a child's sleeping-room on account of the rapid exhaustion of the oxygen which results.

The furniture of the nursery should be of the plainest. Hardwood chairs and tables with enamel or brass cribs or bedsteads should be used. There should be no article of furniture or furnishings in a nursery that

<sup>1</sup> A very severe gonorrhea was contracted by one patient from a nursery maid.

cannot be washed. In the bath-room or in some adjoining room a pail should be kept containing some disinfectant solution, such as carbolic acid, 1 : 100, or carbonate of soda solution, 1 ounce to 2 gallons of water, in which the napkins are placed as soon as soiled.

There should be two shades at each window, a light and a dark one, so that it will be possible to darken the room during the sleeping time, as well as to exclude the early morning light, which is the usual cause of too early waking. Babies should be taught to sleep until at least 6 o'clock in the morning. This is far better for the child and also for the mother if she occupies the same room. The unnecessary habit of an early waking at 4 or 5 o'clock will in most instances readily be broken by keeping the room dark.

The nursery should have suitable means for ventilation. For this purpose, aside from the fireplace, the window-board is of no little service (p. 26).

There should be a thermometer in every child's living-room or nursery. It should register from 70° to 72° F. by day and from 65° to 68° F. by night. The nursery should be given an hour's airing twice a day. The child should sleep in a crib, alone, not with an adult or an older child. The old-fashioned cradle in which generations have been rocked may be an interesting heirloom, but under no circumstances should it be removed from its place in the garret. It is realized that the above suggestions are not applicable in many homes. Nevertheless, if we aim at the ideal, existing conditions, no matter how unpromising, will invariably be made better.

**The Nursing-bottle and Nipple.**—There are two requirements that a nursing-bottle must fulfil: it must have a capacity sufficient for one full feeding and it must be so constructed as to be readily cleansed. The oval bottle with rounded edges answers best. These may be obtained in sizes of from 3 to 9 ounces. As many bottles are needed as there are feedings in twenty-four hours. The bottles should be boiled once a day, scrubbed with a stiff brush with hot borax water, and remain in the borax water until needed. Two teaspoonfuls of borax to a pint of water is the strength usually used. Before using, bottles should be rinsed in plain boiled water. The straight black nipple is also preferred, for the reason that it can be turned inside out and easily cleansed. A nipple which cannot be turned should never be used. After use the nipple should be turned and scrubbed with a stiff brush and borax water—a tablespoonful of borax to a pint of water. When not in use the nipple should be kept in borax water, and before being placed on the bottle it should be rinsed in boiled water. The nipple should be boiled once a day. The blind nipples—those without holes—are the best. Holes of the required size may be made with a red-hot cambric needle.

For the administration of thick feedings which are not easily introduced into the ordinary feeding bottle, the "Hygeia" bottle and nipple have proved satisfactory.

The Breck feeder is described on p. 165.

**Baskets for Early Exercises.**—It is a mistake made in many families to have the baby in the arms a greater part of his waking hours. This practice should be discouraged by physicians, for when the child is held

there is always a tendency to make him sit upright on the arms or knee without proper support. During the early months of life the vertebrae and vertebral ligaments are not sufficiently developed to support the heavy head and trunk. If this thoughtlessness on the part of parents with its attendant dangers were explained, there would be fewer cases of displaced scapulæ and spinal curvature to be treated later. Many cases of spinal curvature are the direct outcome of such early abuse of the spinal column. Still, it is not desirable that the infant should constantly occupy the crib. A large clothes-basket in which a thick blanket and pillow have been placed affords a safe playground for a small baby. For the first few months he will lie on his back and amuse himself in his own peculiar way. After the sixth month, when he may be allowed to sit up for a short time each day, a pillow should be placed behind his back for support. The basket supplies plenty of room for toys and other means

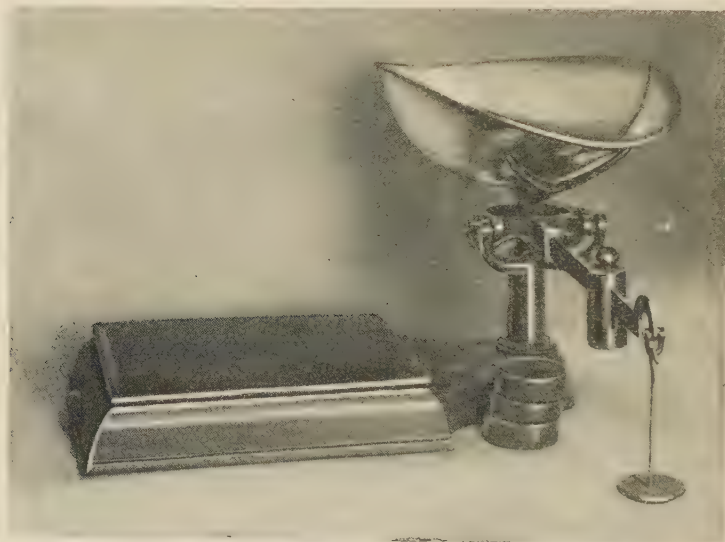


Fig. 1.—Scoop and platform scale.

of entertainment. When the child begins to stand and attempts to walk the basket period is at an end and the exercise pen (p. 839) or screened "coop" should be brought into use.

**Scales.**—A scale for weighing the baby is a very necessary adjunct to the nursery furnishings. There are several varieties of scales on the market known as "baby scales." Their usual construction provides for a basket for holding the baby, the basket being supported by a steel rod which rests upon a spring. A needle indicates on a dial the weight of the child. This variety of scale is very unsatisfactory: it gets out of order easily, it is expensive, and with a vigorous, kicking child, the rapid oscillation of the needle makes an accurate reading of the weight difficult if not impossible. Further, the weight capacity of these scales is but 20 pounds. When the child's weight reaches this figure it necessitates the purchase of another scale. The scoop and platform scales used by grocers (Fig. 1) are best. They do not easily get out of order, they

weigh correctly from  $\frac{1}{2}$  ounce to 280 pounds, and, being very simple in construction, they can readily be understood. The infant rests on his back in the scoop during the weighing process; older children stand on the platform.

## NORMAL DEVELOPMENT

### WEIGHT

The average weight of the full-term, newborn infant varies from 6 to 9 pounds. Some are born at term weighing less than 6 pounds, and a few weighing over 9 pounds, but in the great majority the birth weight will be found between these figures. Holt found from a study of the records of three large maternity institutions in New York city as follows:

The average weight of 568 females was 7.16 pounds.

The average weight of 590 males was 7.55 pounds.

Every family which can afford it should have a scale (p. 32) for weighing the baby, for only by regular weighing during infancy and childhood can we gain an accurate knowledge of growth. During the first three days of life there is usually a loss in weight of 9 or 10 ounces, according to Holt's record, 11 per cent. of the birth weight. After this initial loss, which may be expected, but which does not always occur, a weekly gain in weight is to be looked for, the child regaining the birth weight on the eighth or tenth day. At first it is advisable to weigh twice a week, or even daily, if the child is not progressing satisfactorily. After the second month, when the infant is making satisfactory progress, a weekly weighing will answer, and this should be continued until the child is one year of age. During the second year bimonthly weighings are sufficient. Girls of the same age, after the first year, will average from  $\frac{1}{2}$  to 1 pound lighter than boys. During the third year monthly weighings will be sufficient to enable one to keep in touch with the child's condition. During the first six months of life a weekly gain of 4 to 8 ounces has been made by well children. When a child does not make at least an average gain of 4 ounces weekly we do not put him in the "doing well" class, but look into his care and nutrition to learn what is wrong. Children vary in growing capacity. Some will increase in weight rapidly, gaining 4 ounces a day, while others will make a slower gain and yet be perfectly well. Through the care of many children we have come to regard 4 ounces as the minimum weekly gain for a well child. In a well infant the birth weight should be doubled by the fifth or the sixth month, and at one year the weight should be a little over two and one-half times that at birth. During the second year a gain of  $5\frac{1}{2}$  to 7 pounds will usually result under proper conditions. During the third year from 5 to 6 pounds will be added. It is not to be inferred that these are arbitrary figures or that perfectly well children may not be under or above the figures given at the ages mentioned. These figures are, however, to be regarded as the average for the different ages. Suggestions for the memorizing of weight and height figures are offered on p. 41.

A weight chart with its colored "normal" line will not be found in this book, and physicians are advised against its use. Time and again one sees well infants, though slow in growth, made ill by overfeeding,

in the vain attempts of an ambitious mother or nurse to keep her infant up to the "normal" line. It may be said that the weekly weighing might have similar effect; not so. Here there is nothing for comparison—no normal red line "staring" the mother in the face.

The weighing alone is not sufficient to inform us absolutely concerning the development of children. Condensed milk babies may show

WEIGHT—HEIGHT—AGE TABLE FOR BOYS																		
Height Inches	5 Yrs.	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs.	11 Yrs.	12 Yrs.	13 Yrs.	14 Yrs.	15 Yrs.	16 Yrs.	17 Yrs.	18 Yrs.	19 Yrs.			
38	34	34																
39	35	35																
40	36	36																
41	38	38	38															
42	39	39	39	39														
43	41	41	41	41														
44	44	44	44	44														
45	46	46	46	46	46													
46	47	48	48	48	48													
47	49	50	50	50	50	50												
48		52	53	53	53	53												
49		55	55	55	55	55	55											
50		57	58	58	58	58	58	58										
51			61	61	61	61	61	61										
52			63	64	64	64	64	64	64									
53			66	67	67	67	67	67	68	68								
54				70	70	70	70	71	71	71	72							
55				72	72	73	73	74	74	74	74	80						
56				75	76	77	77	77	78	78	78	83						
57					79	80	81	81	82	83	83							
58					83	84	84	84	85	85	86	87						
59						87	88	89	89	90	90	90	90					
60						91	92	92	93	94	95	96						
61							95	96	97	99	100	103	106					
62							100	101	102	103	104	107	111	116				
63							105	106	107	108	110	113	118	123	127			
64								109	111	113	115	117	121	126	130			
65								114	117	118	120	122	127	131	134			
66									119	122	125	128	132	136	139			
67									124	128	130	134	136	139	142			
68										134	134	137	141	143	147			
69										137	139	143	146	149	152			
70										143	144	145	148	151	155			
71										148	150	151	152	154	159			
72											153	155	156	158	163			
73											157	160	162	164	167			
74											160	164	168	170	171			

PREPARED BY BIRD T. BALDWIN, PH.D., AND THOMAS D. WOOD, M.D.

These new Weight-Height-Age Tables, which are similar to the Wood Tables (formerly issued by the Child Health Organization of America), are the most accurate available.\*

These tables should be used as a means of interesting the child in his growth, and as a factor in determining the child's health and nutrition.\*\*

\* Representing a large group of presumably healthy children most of whom are native born. Tables for technical workers with detailed information can be secured from the American CHILD HEALTH Association.

\*\* Encourage the annual physical examination of every child by a physician.

a most satisfactory weight curve, yet on examination may be found by no means up to the requirements for their age as regards bone and muscle development. A nursing or bottle baby should be examined once a month in order to determine if the progress is along the desired lines as shown by the condition of the teeth, the fontanels, the long bones, and the muscles.

## HEIGHT

From the standpoint of health or development height is of no great significance. The length at birth usually varies from  $19\frac{1}{2}$  to 21 inches. Children suffering from tardy malnutrition, particularly if syphilitic, may be undersized. Not a few of the non-specific malnutrition and

WEIGHT—HEIGHT—AGE TABLE FOR GIRLS																	
Height Inches	5 Yrs.	6 Yrs.	7 Yrs.	8 Yrs.	9 Yrs.	10 Yrs.	11 Yrs.	12 Yrs.	13 Yrs.	14 Yrs.	15 Yrs.	16 Yrs.	17 Yrs.	18 Yrs.			
38	33	33															
39	34	34															
40	36	36	36														
41	37	37	37														
42	39	39	39														
43	41	41	41	41													
44	42	42	42	42													
45	45	45	45	45	45												
46	47	47	47	48	48												
47	49	50	50	50	50	50											
48		52	52	52	52	53	53										
49		54	54	55	55	56	56										
50		56	56	57	58	59	61	62									
51			59	60	61	61	63	65									
52			63	64	64	64	65	67									
53			66	67	67	68	68	69	71								
54				69	70	70	71	71	73								
55				72	74	74	74	75	77	78							
56					76	76	78	79	81	83							
57					80	82	82	82	84	88	92						
58						84	86	86	88	93	96	101					
59						87	90	90	92	96	100	103	104				
60																	
61						91	95	95	97	101	105	108	109	111			
62							99	100	101	105	108	112	113	116			
63							104	105	106	109	113	116	117	118			
64								110	110	112	116	117	119	120			
65								114	115	117	119	120	122	123			
66									118	120	121	122	123	125	128		
67										124	124	125	128	129	130		
68										128	130	131	133	133	135		
69										131	133	135	136	138	138		
70											135	137	138	140	142		
71																	
										136	138	140	142	144			
										138	140	142	144	145			

PREPARED BY BIRD T. BALDWIN, PH.D., AND THOMAS D. WOOD, M.D.

When taking measurements, remove the child's outdoor clothing, shoes and coat. Take heights with a square, consisting of two flat pieces of wood joined at right angles (a chalk box will serve). The child is placed in a good erect position, with heels and shoulders against the wall or wide board, upon which has been marked or pasted an accurate measure. Age is taken to the nearest birthday.

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anemic children are tall and thin. It is often a matter of no little distress to parents that their children are undersized. Short mothers and fathers cannot expect very tall children. If the latter have right care, they will probably be larger than the parents, but cannot be expected to grow as much as playmates whose fathers and mothers are tall. The height bears much less relation to the condition of the child than does the weight.

The following table, taken from Holt and Howland,<sup>1</sup> gives the figures for weight, height, chest, and head circumference from birth to three years of age:

AVERAGE NET WEIGHT, HEIGHT, AND CIRCUMFERENCE OF HEAD AND CHEST OF HEALTHY CHILDREN FROM BIRTH TO THREE YEARS

Age.	Sex.	Weight.		Height.		Chest.		Head.	
		Pounds.	Kilos.	Inches.	Cm.	Inches.	Cm.	Inches.	Cm.
Birth.....	Boys.	7.55	3.43	20.6	52.5	13.4	34.2	13.9	35.2
	Girls.	7.16	3.26	20.5	52.0	13.0	33.0	13.5	34.3
6 months.....	Boys.	16.0	7.26	26.5	67.4	16.5	41.9	17.0	43.2
	Girls.	15.5	7.03	26.0	66.1	16.1	40.8	16.6	42.3
12 months.....	Boys.	21.0	9.54	29.5	75.0	18.0	45.7	18.0	45.7
	Girls.	20.5	9.31	29.0	73.7	17.5	44.5	17.5	44.5
18 months.....	Boys.	24.5	11.13	31.5	80.0	18.7	47.8	18.6	47.5
	Girls.	23.7	10.77	31.0	78.8	18.2	46.2	18.0	45.7
2 years.....	Boys.	27.0	12.27	33.5	85.1	19.3	49.1	19.2	48.7
	Girls.	26.0	11.81	33.0	83.8	18.8	48.0	18.6	47.5
2½ years.....	Boys.	29.7	13.50	35.5	90.2	19.8	50.4	19.5	49.5
	Girls.	28.7	13.04	35.0	89.0	19.3	49.1	19.0	48.2
3 years.....	Boys.	32.0	14.54	37.0	94.0	20.3	51.5	19.8	50.4
	Girls.	31.0	14.09	36.5	92.8	19.8	50.4	19.4	49.3

### THE HEIGHT AND WEIGHT RATIO

About what should be the relation existing between the height and weight for boys and girls of five years and over is shown by the tables on pages 34 and 35, prepared by Dr. Thomas D. Wood and published by the Child Health Organization.<sup>2</sup>

### STANDARDS OTHER THAN WEIGHT AND HEIGHT

**The Midpoint of the Body.**—At birth the midpoint is above, and at one year just below, the umbilicus. At six years the midpoint is midway between the symphysis and umbilicus, and in adult life at the symphysis.

**The Head and Chest Circumferences.**—The figures for these measurements are included in the table above.

The development of the head is a good criterion of the growth of the brain which determines the size of the skull. The skull circumference increases about  $\frac{1}{2}$  inch per month during the first half of the first year and  $\frac{1}{4}$  inch per month during the last half of the first year.

The chest circumference follows very closely that of the head till the third year, then increases much more rapidly than the growth of the head, the increase in chest circumference averaging 1 inch per year from the first to the fifteenth year.

<sup>1</sup> Diseases of Infancy and Childhood, 1923, p. 22.

<sup>2</sup> Copyrighted 1918 by Child Health Organization, 156 Fifth Ave., New York.

**The Abdomen.**—The abdominal measurement corresponds closely to that of the chest up to the third year, at which time the measurements of head, chest, and abdomen are all about equal.

**The Fontanels.**—The lateral are closed at birth, the posterior is closed at two to four months, and the anterior at about eighteen months. At one year the diameter of the anterior fontanel is normally about 1 inch.

**The Blood.**—The composition of the blood presents marked differences dependent upon age. The characteristics of greatest significance in the blood of infancy are mentioned on page 430.

**The Gastric Capacity.**—The *anatomic capacity* is the actual holding volume of the stomach as determined by the measurement of water poured in postmortem at a pressure of 15 cm.

The *physiologic capacity* represents what an infant can take and retain at a nursing. By reason of the fact that immediately after its ingestion milk begins to leave the stomach and pass into the intestine the rule that physiologic capacity is greater than anatomic capacity is readily explained.

Figures representing the anatomic capacity as determined postmortem by Holt are in part as follows:

Birth.....	1.2 ounces
4 weeks.....	2.0 "
8 weeks.....	3.37 "
12 weeks.....	4.5 "
6 months.....	5.75 "

Mosenthal,<sup>1</sup> in a study of 24 cases, found that an amount of 3.6 ounces was ingested at a nursing when the anatomic gastric capacity (determined postmortem) was only 2.6 ounces.

## THE TEETH

Twenty teeth comprise the *first set*. In the well child the first tooth usually appears between the sixth and the eighth months; the first teeth may, however, in perfectly normal cases, come earlier or much later. A perfectly well, vigorous child may not show a tooth until the thirteenth month. The first teeth are usually the two lower central incisors. The four upper incisors and the two lower lateral incisors appear normally between the eighth and the tenth months. The first four molars appear between the twelfth and the fifteenth months; the four canines between the eighteenth and the twenty-fourth months; the four posterior molars, which complete the first set, between the twenty-fourth and the thirtieth months. This regularity in the appearance of the teeth is by no means constant, even in well children. Repeatedly one sees the upper central incisors cut first. Rarely the upper lateral incisors have appeared first. In delayed dentition in rachitis and other forms of malnutrition the teeth are very apt to appear irregularly. In a markedly rachitic dispensary patient the bicuspid were the first teeth cut.

The *permanent set* consists of 32 teeth. The second dentition begins about the sixth year, and is usually completed about the twentieth year, although it may be delayed several years. The permanent teeth appear in somewhat the following order:

<sup>1</sup> Arch. Ped., 1909, xxvi, 761.

First molars .....	sixth year
Central incisors .....	sixth to seventh year
Lateral incisors .....	seventh to eighth year
First bicuspid .....	ninth to tenth year
Second bicuspid .....	ninth to tenth year
Canines .....	eleventh to twelfth year
Second molars .....	thirteenth to fifteenth year
Third molars .....	after the eighteenth year

**Care of the Teeth.**—As soon as the teeth appear they require attention. Until the second year is reached the mouth should be cleansed at least twice a day with a solution of boric acid— $\frac{1}{2}$  ounce to a pint of water. This can best be done by means of absorbent cotton wound around the tip of a clean index-finger and afterward dipped in the solution, which should be applied with gentle friction to the gums and teeth. When a child is two years old it is well to begin the use of a soft tooth-brush and a simple tooth-powder composed of the following ingredients:

Precipitated chalk .....	3j
Bicarbonate of soda .....	3j
Oil of wintergreen .....	q. s.

The child should also be instructed as to the proper use of a quill toothpick. The teeth of every child over two years of age should be examined by a dentist every six months. Cavities discovered in the first teeth should be filled with a soft filling.

The milk teeth are lost between the sixth and the eighth years. They should not decay, but fall out or be forced out by the second set.

**The Calcification of the Teeth.**—This begins *in utero*. The normal progress of calcification is most important if the permanent teeth are to present no hypoplasia or deficiency of enamel.

In a consideration of the teeth in rickets, Dick<sup>1</sup> has clearly shown by diagram the steps by which calcification proceeds and the effects of hypoplasia of enamel due to rickets, as exhibited in the permanent set. Of this set the central and lateral incisors, the canines and the first molars, undergo comparatively advanced calcification in the first two years of life. Consequently these teeth in late childhood show the extensive inroads of a possibly forgotten rickets which has conformed to the fairly constant law of incidence and greatest activity between the ages of six months and two years. (See page 123.)

#### SPECIAL MENTAL AND PHYSICAL DEVELOPMENT IN THE INFANT

Dr. Frederick Peterson,<sup>2</sup> of New York, made an exhaustive study of the mental development of the newborn.

In all, 1060 newborn infants were examined, the observations extending for one year. His observations, which are to be looked upon as authentic, are as follows:

**"1. Sight.**—Sensibility to light is present in most infants at birth, and this is the case even in those prematurely born. The optic nerve

<sup>1</sup> J. Lawson Dick, *Rickets*, 1922.

<sup>2</sup> *Bulletin, Lying-in Hospital*, December, 1910.

is, therefore, already prepared to receive impressions, sometimes even before the time of normal birth.

"2. **Hearing.**—Sensibility to sound is quite as apparent as sensibility to light at birth, for 276 normal white children reacted to sound on the first day of life and 146 reacted to light. A similar condition existed among the premature infants, many reacting to sound on the first day as well as to light. The auditory nerve is already prepared to receive impressions of sound sometimes before the period of normal birth. This is wholly contrary to the opinions of other authorities.

"3. **Taste.**—The gustatory nerve not only reacts differently to salt, sweet, bitter, and sour at birth, but the same mimetic reactions are observed in premature infants. This nerve is, therefore, ready to receive taste impressions some time before the normal period of birth.

"4. **Smell.**—Two hundred and seven normal white children reacted to odors on the first day of birth, and similar reactions were observed in premature infants. The olfactory nerve is ready to receive smell impressions some time before the end of the normal period of gestation.

"5. **Cutaneous Sensibility.**—Reactions to touch and temperature and affective manifestations of discomfort, obtained the first day in large numbers of normal infants, were similarly obtained in premature infants, showing that such sensibility is already present before the expiration of the period of normal gestation. There is every reason to believe that sensitiveness to painful stimuli is present, but the reactions are more vague and uncertain than in later life, which leads many to assume that the sense of pain is dull in the newborn. Muscular sense cannot be tested in infants, but there is every reason to believe that muscular sense, the sense of motion, and sense of position are developed early *in utero*.

"6. **Thirst-hunger and Organic Sensation.**—The newborn child frequently reacts to thirst-hunger on the first day, though the actual need of food is seldom apparent until after the first or second day. Discomfort is clearly marked when nourishment is not forthcoming. The cries of discomfort and pain are marked in the first day in full-term infants and noteworthy in the premature.

"7. **The Beginning of Memory, Feeling, and Consciousness in the Newborn Child.**—There are good grounds for believing that the newborn child comes to the world already with a small store of experiences and associated feelings and shadowy consciousness. The fact that even in premature infants we find the senses already prepared for the reception of impressions on the five senses is some evidence of such impressions having been already received and stored up in the dim storehouse of a memory already begun. It may even be that some sort of vague light impressions have been received, for it is possible that in the interior of the body the alternation of day and night may in a mild degree be manifested. The transillumination of the hands before a candle, of the skull and face bones by examination of the frontal sinuses and antrum with electric lights, are evidences of a certain amount of translucency of the whole organism to sunlight, which is so much more powerful than any artificial light. There is greater possibility in the matter of the auditory sense, that it may be stimulated by sounds within the body of the mother (by bone conduction possibly)—such sounds as the beats

of the maternal and fetal hearts, the uterine and funic souffles, and the bruit of the maternal aorta.

"Moderate stimulation of the gustatory nerve is thought to occur through the common swallowing of amniotic fluid by the fetus.

"A marked development of receptivity in the senses of touch and of muscular sense during uterine life is undisputed. Movements begin considerably before the sixteenth week of pregnancy, and increase in character and extent from that time on. Often they are so violent as to be painful to the mother. The activity of the muscles and constant contact of various parts of the fetal body with the uterine walls for a period of months before birth must lay a foundation under the threshold of consciousness for a sense of equilibrium and vague spatial relations. The material basis of consciousness is prepared long before birth.

"There is already a feeling tone associated with the earliest reactions, though we are altogether in the dark as regards its psychophysiology. The process has been thus formulated: Stimulus—reaction—liking—reinforcement. Stimulus—reaction—dislike or pain—inhibition. This is the early simple associative memory in reactions to stimuli.

"8. There are no perceptible differences in reactions of colored and white children or between pairs of twins.

"**Ability to Hold the Head Erect.**—This may be acquired at the third month. Few infants, however, are able fully to support the head before the fifth month. Not a few perfectly normal infants will not be able to support the head before the ninth month.

"**Sitting Erect.**—The ability to sit erect unsupported is acquired between the sixth and eighth months.

"**Standing.**—Many infants will stand with simply hand support at the tenth month. Exceptionally well-developed infants will stand with the hands resting on some object at the eighth month. A remarkable infant under my observation could stand at the fifth month, and walked alone at the eighth month. The average infant walks alone from the fourteenth to the sixteenth month. A few will be able to walk unsupported before this period, and other normal children will not walk alone before the eighteenth or twentieth month.

"**Laughing.**—Many infants may be made to laugh from the third to the sixth week.

"**Memory.**—The infant's memory is very short. I have repeatedly known infants eighteen months of age who have entirely forgotten the mother in a week.

"**Speech.**—Intelligible words are formed at about the twelfth month. From the eighteenth month to the second year two or three words will be intelligently put together."

**Sleep and Crying.**—These are physiologic phenomena exhibiting variations dependent on growth of the finer senses and muscular powers and belong to the criteria indicating normal development. Their consideration has already been taken up (p. 28).

## SUGGESTIONS FOR MEMORIZING FACTS PERTAINING TO GROWTH AND DEVELOPMENT

If proper allowance be made for minor inaccuracies which reference to the standards given will readily correct, the multiplication table of the number 7 may be used as an association link in fixing many of the figures of growth and development in the reader's mind:

7 equals the approximate weight in pounds at birth, the approximate month of life when the infant sits up and when he cuts his first tooth, the approximate year of life when he enters upon his second dentition.

$7 \times 2$  equals 14, the approximate circumference in inches of the head and chest at birth and the number of the month when walking is unassisted.

$7 \times 3$  equals 21, the approximate length in inches of the body at birth, the approximate weight figure for one year, the number of the month when the anterior fontanel is closed, and a little more than the circumference of head, chest, and abdomen at three years.

$7 \times 4$  equal 28, the approximate weight in pounds at two years and the height in inches at one year.

$7 \times 7$  equals 49, the figure for both weight and height at seven years.

In addition, it is easy to remember that the ordinary child doubles his weight at five months and trebles it at one year, and that the weight increase from two to seven years ranges between 4 and 5 pounds per year.

## II. INFANT FEEDING

### MATERNAL NURSING

#### THE PROBLEM

WRITERS on this subject are very prone to state that the ability of the mother, particularly among the well-to-do, to fulfil this most important function is surely decreasing. Although this may have been a true statement twenty years ago, at the present time it is undoubtedly erroneous. That the young mother of today is better able to nurse her offspring than was her sister fifteen or twenty years ago is, moreover, explained by the fact that the youth of the present day are more vigorous, more nearly normal individuals than were those of an earlier date.

The inability adequately to perform the nursing function has always been attributed to the mother *ipse*. This belief, too, is in error. A child born with a generally enfeebled vitality keenly feels any slight abnormality in the milk, or may not be able to digest perfectly normal milk; in either event, the milk disagrees and the nursing is discontinued. Breast milk during the first two or three weeks of the infant's life is produced under unfavorable conditions which do not indicate the possibilities of the breast as a secreting organ, and early nursing, following as it does upon the stress of confinement, is not indicative of what may be possible later when the customary life and daily habits are resumed. Repeatedly a very high fat or a high protein, or both, have been shown to be entirely corrected after the first week or two without interference. This condition at the time was considered sufficiently serious to warrant the discontinuance of nursing on the part of a weakly infant, while in a vigorous infant it would be entirely ignored.

The change which enables more mothers successfully to nurse their infants is due to two causes—more vigorous fathers and mothers and more vigorous offspring. The more normal the mother, the better able is she to perform this normal function. That this is the case is due without doubt to the fact that growing girls and young women are leading more hygienic lives than formerly. The making of golf, bicycle and horseback riding, boating, and automobiling popular and fashionable—in short, the taking of girls out-of-doors and keeping them there a considerable portion of the day—has worked a marvelous change for the better, both physically and mentally. Proportionate to the population, there are fewer neurasthenics among the young women today than there were twenty years ago, and there will be still fewer twenty years hence, because at the present time the timid, retiring young woman of the neurasthenic type is not popular in her set. It is very fortunate for the future of the human race, at least for that portion which resides in the United States, that the young woman has thus transferred her allegiance from the crochet and embroidery needle to out-of-door sports, for a neurotic mother makes the poorest possible milk producer.

While it may be said that our argument holds only with the wealthy or the well-to-do, nevertheless imitation is one of the strongest characteristics of the human race, and this tendency in America to outdoor hygienic living pervades all classes. Saturday half-holidays, and the excursions and outings afforded by reduced rates in transportation, are much more popular than they were twenty years ago. Finally, food is better selected and better prepared, owing to increased knowledge on the part of the people as to what constitutes proper nutrition.

It may be thought that we have wandered from our subject—maternal nursing—but such is not the case, for conditions which relate even remotely to this important function demand our respectful consideration. The food and care of the growing girl have the most intimate bearing upon her future life, and if she is to be called upon to perform the most important function of womanhood, she surely has the right to demand that she receive during her girlhood proper preparation, which heretofore has too often been denied her.

It is not pleasant to criticize physicians, but we venture that the family physician does not, in a great majority of instances, fulfil his function, or extend his field of usefulness to its full capacity, his conception of duty too often including only the care of the sick. Unsought advice concerning the feeding and daily habits of a child's life is usually welcomed and appreciated, for the reason that in almost every instance errors in a child's management are due to ignorance. Parents, no matter what their station in life, are glad to do what is for the best interests of their children when the reason for certain procedures is made clear.

If a thorough and careful physician can have the physical direction of 10 average girls in any station in life, provided they have the benefit of fresh air and good food from infancy to adolescence, he may confidently predict that successful nursing mothers will be made out of 8 of them.

Certain rules of life having a direct bearing on nursing thus lead us nearer the ideal and may enable the mother who otherwise could not nurse her child to do so successfully. These requirements, it will be seen, are laid along common sense lines and cause no hardship or mental distress, one of the chief requirements of a nursing woman being that she shall be mentally normal.

Some mothers will be able to carry on the nursing for only two months; others, three, five, seven, or nine months. After the ninth month it is extremely rare for the breast milk to be sufficient for a child.

The most successful nursing age is between the twentieth and thirty-fifth years. Successful nursing carried on by a girl of fourteen, by a woman of fifty-two, and by the much abused society girl has been noted, while it has been seen to fail absolutely in peasant women fresh from the fields of Hungary and Bohemia. Many whose nursing is at first most unsatisfactory develop into perfect nurses.

Finally, few functions with which we are called to deal are so variable and uncertain as the production of breast milk. Breast milk is one of the most precious substances. It is invaluable—unless we can put a value on human life.

## HUMAN MILK

While human milk varies as to the proportion of its nutritional elements at different periods of lactation, and even at different times of the day, milks upon which infants thrive agree within certain limits, so that a standard of limitations may be laid down. Among a great many specimens examined the solids have ranged between 12 and 13 per cent. The range in fat has been from 2.75 to 4.65 per cent., protein from 0.9 to 1.8 per cent., sugar from 5.50 to 7.3 per cent. These figures represent the analyses of the breast milks given children who were thriving and who were of different ages. The variations are not as wide as have been reported by others, but it is to be remembered that all these babies were thriving. Whoever has examined breast milk even a few times is aware of the existence of the widest possible variations. One may see breast milks which contain 8 per cent. and others which contain only 0.5 per cent. of fat; but infants thus fed have not been well.

Fat exists in mother's milk as minute globules in emulsion, varying somewhat in composition, depending upon the kind of food eaten.

The proteins of breast milk offer a wide field for further study. There are several of these, the most important being casein and lactalbumin. The proportions are subject to considerable variation, depending upon the diet and habits of life of the producer. With a continuation of lactation there is a diminution of the protein, so that at the ninth or tenth month the total protein is considerably reduced, often being not over 1 per cent.

The sugar content varies less than does either the fat or protein, its range of limitation, even in milk otherwise poor, being rarely over 2 per cent.

**Examination of Human Milk.**—Milk of the mother is usually examined to determine whether it contains a sufficient amount of fat, sugar, and protein to nourish the infant; or to determine whether the quantity of one or more of the nutritional factors is excessive or deficient. Microscopic examination shows us little except the presence of colostrum, which usually disappears about the ninth day and is to be considered abnormal if present after the twelfth day. The presence of blood and pus may also be detected by the microscope. For an accurate analysis the milk should be sent to a laboratory properly equipped for such work. For absolute accuracy it is not safe to judge from the analysis of one specimen of milk; at least two, better three, specimens should be analyzed before coming to a conclusion. In collecting milk for examination the middle of a nursing should be selected.

Laboratory analysis is expensive, however, and beyond the possibilities of many. For out-patient work and those cases in which a determination of approximate percentages is sufficient the Holt milk set is of great service. The set consists of a lactometer and two cream gages. The method of its use as explained by Holt is as follows:

*Fat Determination.*—"The simplest method is by the cream gage. Its results are only approximate, but in most cases sufficiently accurate for clinical purposes. The tube, filled to the zero mark with fresh milk, stands, corked, at room temperature for twenty-four hours, when the

percentage of cream is read off. The ratio of this to the fat is approximately 5 to 3; thus 5 per cent. cream indicates 3 per cent fat, etc."

"For an accurate determination the best method is the Babcock test, which requires 20 c.c. of milk, or the modification by Lewi of the Leffman and Beam test for cow's milk. This requires special tubes."

*Sugar Determination.*—There is no accurate clinical method for determining the amount of sugar; only a chemical analysis is reliable. However, the sugar varies less in different milks than do the fat and protein and its variations are of much less importance clinically.

*Protein Estimation.*—"Clinical methods for the estimation of the protein are not very satisfactory. We may form some idea of the protein from a knowledge of the specific gravity and the percentage of fat if we regard the sugar and salts as constant, or so nearly so as not to affect the specific gravity. We may thus determine whether it is greatly in excess or very low, which, after all, is the important fact. The specific gravity will then vary directly with the proportion of protein, and inversely with the proportion of fat, *i. e.*, high protein, high specific gravity; high fat, low specific gravity."

By subtracting the sum of the percentage of fat and the estimated sugar and ash percentages from that of the total solids a fair calculation of the percentage of protein in a given sample of milk may be made. For accurate estimation the method of Van Slyke and Bosworth<sup>1</sup> may be used to determine the casein percentage which multiplied by 1.4 gives with sufficient accuracy the total protein percentage.

"A specimen taken for examination should be either the middle portion of the milk—*i. e.*, after nursing two or three minutes—or, better, the entire quantity from one breast. The first milk is slightly richer in protein and much poorer in fat. The last drawn from the breasts is lower in protein and much higher in fat. The following analyses from Forster illustrate these differences":

	First portion, per cent.	Second portion, per cent.	Third portion, per cent.
Fat.....	1.71	2.77	5.51
Protein.....	1.13	0.94	0.71

## BREAST FEEDING

**Fundamental Rules.**—The following may be laid down as nursing axioms:

A diet similar to what the mother was accustomed to before the advent of motherhood should be taken.

There should be one bowel evacuation daily.

From three to four hours daily should be spent in the open air in exercise which does not fatigue.

At least eight hours out of every twenty-four should be given to sleep.

There should be absolute regularity in nursing.

There should be no worry and no excitement.

The mother should be temperate in all things.

<sup>1</sup> New York Med. Jour., 1909, xc, 542.

In addition to these fundamental axioms certain rules applicable to the details of nursing should be remembered.

Twenty minutes is the maximum time during which a baby should be allowed to remain at the breast. In most instances the twenty minutes is too long. (See Rate of Milk Secretion, p. 49.) On no account should the infant be allowed to sleep at the breast.

The three-hour interval between feedings is best in most instances, at least until the completion of the third or fourth month.

One breast at a nursing should be given if the milk is plentiful. If the supply is not enough, both breasts may be given at the same feeding period.

After the nursing the baby should be held up against the mother's shoulder and patted gently on the back to allow eructation of air from the stomach.

Finally, after the baby has been put down, and before the cleansing of the mother's nipples, massage of her breasts is desirable as a means of expressing any residual milk and of stimulating the productive activity of the glands. The value of such breast massage in cases of deficient lactation has been repeatedly demonstrated.

**Early Giving of Water.**—From  $\frac{1}{2}$  to 1 ounce of a 5 per cent. solution of milk-sugar should be given the infant every two hours until the milk appears in the breast. Otherwise there will be unnecessary loss in weight and perhaps a high degree of fever due to inanition.

If the baby is restless and uncomfortable, it is safe to conclude that he is thirsty; 1 ounce of the sugar-water will usually satisfy him. With the commencement of nursing he should be accustomed to getting his food at regular intervals.

**The First Nursing.**—Six hours after delivery or confinement the nipples should be washed with a saturated solution of boric acid and the child put to the breast and nursing attempted. After this the attempts at nursing should be repeated every four hours, although the milk does not appear in the breasts until from forty-eight to seventy-two hours after the birth. Colostrum may be present. It is useful as a laxative and may satisfy the child. Further advantages of early nursing are that it promotes uterine involution and gradually accustoms both the infant and the mother to what will be required later.

**Care of the Nipples.**—Immediately after the nursing the nipple should be carefully washed with a saturated solution of boric acid and thoroughly but gently dried. A baby should never be allowed to nurse from a cracked or fissured nipple. For this very painful condition a nipple-shield (Fig. 2) should always be used. (See p. 53.)

**The Diet.**—Many times, when consulted by a nursing mother because the nursing was unsuccessful or a partial failure, the physician finds that her diet has been restricted to an extreme degree. To put on a greatly restricted diet a robust young mother who has always eaten bountifully of a generous variety of foods is one of the best means of curtailing the quantity and lowering the quality of her milk supply. When asked to prescribe a diet one may safely tell such mothers to eat as they were accustomed to before the advent of pregnancy and motherhood. That this particular vegetable or that particular fruit should be forbidden on

general principles is a fallacy. Food that the patient can digest without inconvenience is a safe food so far as the nursing is concerned, as may readily be determined in any given case. For certain individuals, however, a plain, more or less restricted diet is desirable. This must be remembered in the management of the wet-nurse (p. 56). Many a wet-nurse who has been carefully selected, and who to the best of our judgment should prove satisfactory, utterly fails in a few days to fulfil the duties of the office for which she was chosen. In not a few instances the failure is due to a very full diet of unusual articles of food, the existence of which, in many instances, she never dreamed of. Indigestion and constipation follow, both the nurse and the baby are made ill, and the woman's usefulness ceases. A woman who has lived and kept well on the diet and food found in the home of the laboring man, whether in the city or country, will make a far better wet-nurse on this diet than if she indulges in food to which she is entirely unaccustomed. In general, the diet of a nursing mother, then, should be that to which she has been accustomed.

Nursing is a perfectly normal function, and a woman should be permitted to carry it out along only natural lines. Inasmuch as there are two lives to be provided for instead of one, more food, particularly of a liquid character, may be taken than the mother may have been accustomed to. It is customary to advise that milk be given freely. A glass of milk may be taken in the middle of the afternoon and 8 ounces of milk with 8 ounces of oatmeal or cornmeal gruel at bedtime, if it does not disagree with the patient. Our only evidence that a food is not disagreeing is the condition of the digestion. When any article of food disagrees with the mother, or if she is convinced that it disagrees, whether or not such is really the case, the food should be discontinued. In a general way, milk in quantities not over one quart daily, eggs, meat, fish, poultry, cereals, green vegetables, and stewed fruit constitute a basis for selection. The method of preparation of the different meals is not arbitrary.

**The Bowel Function.**—A very important and often neglected matter in relation to nursing is the condition of the bowels. There must be one free evacuation daily. For the treatment of constipation in nursing women different methods have been tried in many cases. The dietetic treatment does not promise much. For here, again, manipulation of the diet may interfere with the milk production. Three methods are open to use—massage, local measures, and drugs. Massage is available in comparatively few cases. Local measures consist in the use of enemas or suppositories. Every nursing woman should use an enema at bedtime



Fig. 2.—Nipple-shield.

if no evacuation of the bowels has taken place during the previous twenty-four hours. Many out-patients, in whom constipation is a frequent symptom, indulge in excessive tea drinking, often taking from 1 to 2 gallons of tea daily. In treating such patients where an absolute discontinuance of the tea drinking is often impossible and not absolutely necessary one may allow 2 cups a day. For a laxative in such cases and in many others a capsule of the following composition has served well:

R.	Extracti belladonnæ.....	gr. $\frac{1}{2}$
	Extracti nucis vomicæ.....	gr. $\frac{1}{4}$
	Extracti cascariæ sagradæ.....	gr. V
M.	et ft. capsula No. i.	
Sig.	—To be taken at bedtime.	

The amount of the cascara sagrada may be varied as the case may require. In not a few instances it will be found necessary to give two capsules a day in order to produce the desired result. Neither the belladonna, the nux vomica, nor the cascara appears to have any appreciable effect on the child.

**Air and Exercise.**—Outdoor life and exercise are not only as desirable here as they are under all other conditions, but to the nursing woman, with her added responsibility, they are doubly valuable. In order to get the best results exercise or work should so be adjusted as not to reach the point of fatigue. The mother whose nights are disturbed should be given the benefit of a midday rest of an hour or two. She should have at least eight hours' sleep out of every twenty-four. Certain annoyances, anxieties, and worries are inseparable from the life of every child-bearing woman. It should be our duty, however, to explain to the mother and to other members of the family that an important element in satisfactory nursing is a tranquil mind. During the lactation period she should be spared all unnecessary care and petty annoyances.

**Regularity in Nursing.**—The breast which is emptied at definite intervals invariably functionates better than does one which is not, not only as regards the quantity but also the quality, of the milk; so that system in breast feeding is almost as essential to milk production as to its digestion and assimilation.

After it is demonstrated that the nursing is progressing satisfactorily, as proved by the satisfied, thriving child, it is well to begin with one bottle feeding daily. The advisability of this is obvious: in case of illness of the mother, if she is called away from home, or if, for any reason, the child cannot have the breast, the feeding is provided for. Another advantage of this provision is that it gives the mother needed freedom from restraint. She is thus enabled to have the benefit of a change of scene. Amusements and recreations which the invariable nursing period denies her can be indulged in. As a result of this greater freedom she is able to supply better milk and to continue nursing longer than if tied continually to the baby, no matter how fond of the infant she may be.

**Frequency of Nursing.**—From birth until the third month seven nursings in twenty-four hours are allowed as follows: 6 and 9 A. M., 12 M., 3 and 6 P. M., and 2 A. M. From the third to the completion of the six month, six nursings, as follows: 6 and 9 A. M., 12 M., 3, 6, and 10

P. M. After the sixth month, and in large strong children after the fifth month, five nursings in twenty-four hours, as follows: 6 and 10 A. M., 2, 6, and 10 P. M.

**Determination of the Milk Supply.**—Whether or not the child is getting a sufficient quantity of milk may be determined by weighing the baby before and after nursing. For this purpose the scales used for weighing children should weigh accurately in half-ounces. The child, who need not be undressed, should be weighed when put to the breast and weighed at the completion of the nursing. Repeatedly one will find that an infant who should get 3 ounces or more at a feeding during the fifteen-minute nursing increases in weight but  $\frac{1}{2}$  to 1 ounce, showing that only so much milk has been taken. Occasionally cases have been seen which showed no gain whatever after nursing and yet the child was supposed to have been fed. In the event of difficult breast feeding it is well for the physician personally to supervise a nursing or two, for by this means much valuable information may be gained.

**The Rate of Milk Secretion.**—After a study of the rate of secretion of breast milk in a group of cases at Bellevue Hospital, Smith and Merritt<sup>1</sup> stated that nursing infants obtain from 40 to 60 per cent. of their supply in the first two minutes and from 60 to 85 per cent. in the first four minutes, only the larger, vigorous infants nursing from an abundant supply getting milk up to sixteen minutes. These observers concluded "A baby who needs both breasts may nurse from six to eight minutes on the first and from five to seven on the second. Very few babies need as long as ten minutes on a breast. A good many will empty the breast in four or five minutes."

**Signs of Successful Nursing.**—The normal infant shows a gain of not less than 4 ounces weekly. This is the minimum weekly gain which may safely be allowed. When a nursing baby remains stationary in weight or makes a gain of but 2 or 3 ounces a week, something is wrong, and the defect will usually, but not invariably, be found in the milk supply. When the baby is nursed at proper intervals and the supply of milk is ample and of good quality, he is satisfied at the completion of the nursing. Under three months of age he falls asleep after ten or twenty minutes at the breast. When the nursing period again approaches, he becomes restless and unhappy, crying lustily if the nursing is delayed. When the breast is offered, he takes it greedily. The stools are yellow and number from two to three daily. The weekly gain in weight under such conditions is usually from 6 to 8 ounces.

**Signs and Causes of Unsuccessful Nursing.**—Theoretically, every normal breast infant should be a thriving, well baby. That the standard established for a well baby is not upheld is unfortunate. When the supply of milk is scanty the child remains long at the breast, cries when he is removed, and shows signs of hunger before the nursing hour arrives.

A cause of failure in breast feeding, and probably the most frequent cause, is a scanty milk supply.

The chief nutritional elements in mother's milk are: fat, 3 to 4 per cent.; sugar, 7 per cent.; protein, 1.5 per cent. Failure may be due to a marked disproportion of these elements, which may cause sufficient

<sup>1</sup> The Rate of Secretion of Breast Milk, Amer. Jour. Dis. Child., November, 1922.

indigestion and resulting loss in weight to necessitate a discontinuance of nursing. Thus there may be a high fat—from 5 to 6 per cent.; or very low fat—from 1 to 1.5 per cent. In the *high fat cases* there is usually diarrhea with green, watery stools. The child strains a great deal and there are green stains on many of the napkins. In high fat cases there is also regurgitation or vomiting of sour material. The fat globules may readily be made out if the vomited material is placed under a low-power microscope. Low fat means deficient nourishment and may cause constipation. *Sugar* is rarely a cause of trouble in nursing babies. It seldom varies, ranging from 5 to 7 per cent. in the great majority of breast milks. Young children, further, have a marked toleration for sugar. The *protein* of mother's milk is a most frequent cause of nursing difficulties. Like the fat, the protein may be so decreased that nutritional disorder may be induced in the patient, or it may be very much increased, the latter condition being usually the cause of colic or constipation in otherwise healthy nursing infants. In such cases curds may be found in the stools, the passage of which is always accompanied by a great deal of gas.

The milk may contain the normal percentage of fat, sugar, and protein, but be scanty in amount. Instead of the 4 or 5 ounces to which the child is entitled, he may get but 1 or 2 ounces. Whether or not the quantity is sufficient may be determined by weighing the baby before and after each nursing for twenty-four hours. One ounce of breast milk weighs practically 1 ounce avoirdupois. The quality or strength is determined by an examination of the milk itself (p. 44). The quantity is determined by noting the weight of the child, wearing the same clothing, before and after nursing. By nursing for fifteen minutes a child under one week old should gain from 1 to 1½ ounces; at three weeks of age, 1½ to 2 ounces; four to eight weeks of age, 2 to 3 ounces; eight to sixteen weeks of age, 3 to 4 ounces; sixteen to twenty-four weeks of age, 4 to 6 ounces; six to nine months of age, 6 to 8 ounces; nine to twelve months of age, 8 to 9 ounces. Of course, arbitrary limits cannot be fixed as to the quantity. Stationary weight or loss in weight, with a dissatisfied child, usually means a deficiency of milk, which is readily proved by the weighing.

To be fed at the breast may also cause the child to suffer from an excess of good milk, in which event there will be vomiting or regurgitation, usually associated with colic. When this overfeeding continues, dilatation of the stomach develops, vomiting becomes habitual, the child loses in weight, the breast milk is said not to agree, and often, unfortunately, the baby is weaned. This has been the outcome in scores of cases. When there is habitual vomiting and colic in a nursing baby, two things are to be done—the baby must be weighed before and after nursing, and the milk must be examined.

Repeatedly children treated for indigestion have been entirely relieved by shortening the nursing period. Weighing the baby at intervals of from three to five minutes and noting the gain has shown that the 3 or 4 ounces which may represent the child's stomach capacity were obtained in two, three, or five minutes, the excess which the child took over this amount being the cause of his trouble. From a free, full breast a vig-

orous nurser will take one ounce in one minute. When the nursing "gait" is established, a child should be kept up to the schedule. There are few more pernicious teachings than that a baby should be allowed to nurse when he wants to and as long as he wants to. In fact, the idea that a nursing infant will take no more than is good for him is the fruit of inexperience.

*Illustrative Case.*—A mother sought advice regarding giving her one-month-old baby the bottle, as he had many green stools, cried a great part of his waking hours, and weighed but a few ounces more than at birth. Her milk was supposed to be "too strong" for the child. An examination of the breast and a talk with the mother indicated that the breast milk was not at fault. An examination of the milk proved it to be good average milk, containing 3.5 per cent. fat, 6 per cent. sugar, 1.45 per cent. protein. A one day's test by weighing was instituted. The infant was allowed to nurse one minute and rest one minute. During the resting period he was weighed. In this way it was found that in three minutes he got from 3 to 3½ ounces of milk. The nursing was then reduced to three minutes on one breast and five minutes on the other, which was the "slower" breast. Thereupon every sign of indigestion promptly disappeared, the stools became normal, and the infant made a satisfactory gain in weight of 1 ounce daily.

The quantity may be suitable for the age, the child may not vomit or show a sign of indigestion, and yet may not thrive. In such a case an examination or repeated examinations of the milk at intervals of two or three days will usually show that it is poor, below the normal perhaps in both fat and protein.

*Illustrative Case.*—A Swedish woman was admitted to the New York Infant Asylum with an infant two months old in fair condition. The woman had an abundance of milk and asked for a foster-child, so great was her discomfort from the excessive flow of milk. The weekly weighings of the children soon revealed that there was no growth, and after a few weeks both children upon examination showed developing rickets. The milk was then examined and was found deficient—fat, 1.2 per cent.; sugar, 5 per cent., and protein, 0.73 per cent.

**Signs of Insufficient Nursing.**—The baby remains long at the breast, perhaps one-half to three-quarters of an hour. When removed he is restless and uncomfortable. After a short time, in an hour or less, he is very hungry and demands frequent nursings day and night.

**Conditions Which May Temporarily Produce an Unfavorable Effect Upon the Breast Milk, but Not Necessitate the Discontinuance of Nursing.**—The advent of the first menstruation period particularly, and in some cases the beginning of every menstruation period, is attended with an attack of colic or indigestion in the child. Such attacks, however, rarely necessitate the discontinuance of the nursing even for a single day.

Factors influencing the mental condition of the mother, such as anger, fright, worry, shock, distress, sorrow, or the witnessing of an accident, may affect the milk secretion sufficiently to cause no little discomfort to the child, and often lessening of the flow for a day or two.

*Illustrative Case.*—In the County Branch of the New York Infant Asylum there were at one time about 200 nursing mothers, the majority of them from the lower walks of life, at least 95 per cent. of the infants being illegitimate. The necessity of placing a considerable number of these mothers in wards, in close social contact, gave rise to rather frequent disputes, and not infrequently to fistic encounters of a decidedly vigorous character. After a particularly active disturbance, several nursing infants in the ward would become suddenly ill, usually with vomiting, diarrhea, and fever. One

soon learned to know the cause when inquiry or hasty inspection showed that the mothers of those who were ill had been particularly active in the dispute. A small proportion of the mothers were from the better walks of life. Letters of forgiveness or reproach or visits of a like nature from fathers, mothers, or sisters have brought many a sick baby to attention and caused many anxious moments.

**Conditions Which Call for Temporary Discontinuance of Nursing.**—During an acute illness with fever, such as indigestion, tonsillitis, and minor illnesses of a like nature, nursing should be discontinued for a day or two. During this period it should be our effort to maintain the flow of the milk. This is best done by emptying the breast with a breast-pump (p. 54) at the usual nursing period until the time arrives when the nursing may be resumed. In such conditions the advantage of having the baby accustomed to one bottle a day will at once be appreciated.

**Management of Abnormal Milk Conditions.**—When it is found that the breast milk is too strong or too weak, or when the normal ratio of fat, sugar, and protein is not maintained, it may be possible to increase or diminish the milk strength. When desirable, it may also be possible to increase either the fat or the protein. The heavy milk will usually be found in mothers who are robust, who eat heartily, and who take but little exercise. In such a case the prescribing of a plain diet, allowing red meat but once a day, discontinuing the malt liquors or wine—which it will often be found that the mother is taking—and directing that she walk a mile or two a day, will frequently bring the milk to digestible proportions. In some cases, however, this will not be successful, and the colic, constipation, and vomiting may continue, even though the quantity obtained at each nursing is within normal limits. In some instances it will be impossible to change the mode of the mother's life, except perhaps in the discontinuance of alcohol. When such conditions prevail, the milk may be modified by giving from  $\frac{1}{2}$  to 1 ounce of boiled water or plain barley-water before each nursing. One teaspoonful of lime-water added to 1 ounce of water before each nursing has made the breast milk agree when otherwise breast feeding would have been impossible. When the milk is deficient both in fat and protein, a diet composed largely of red meat, poultry, fish, rye bread, or whole-wheat bread, oatmeal, cornmeal, with 2 or 3 pints of milk daily, will often be followed by an increase both in fat and protein. The use of alcohol in moderate amounts, in the form of malt liquors or wine, will often increase the fat 2 per cent. in from two to three days. Disappointments in improving the quantity or quality of the breast milk, however, are frequent. In general, it may be stated that if a mother has been getting adequate nourishment in appropriate form to satisfy her desire, the possibility of improving her breast milk by measures such as those just outlined is by no means as good as in the case of a poorly nourished, underfed woman.

In addition to the one bottle which, for reasons above mentioned, is given early in the child's life, it is necessary at the seventh month to add an extra bottle or two. Usually at this time the protein in human milk begins to diminish in quantity, and as this is the most important nutritional element, an insufficient quantity at this rapidly growing period of life is of no little importance. At the twelfth month, with very

few exceptions, exclusive breast feeding, if one consider the best interests of the child, is practically out of the question. Out of many thousands of cases we recall but one instance when a mother was able *successfully* to nurse her child after the twelfth month. This remarkable woman, a mother of 6 children, had nursed every one of them exclusively up to the fifteenth or the eighteenth month.

**Management of Abnormal Breast Conditions.**—*Cracked and Fissured Nipples.*—Fissures of the nipples often result from lack of care and cleanliness. Nipples that are not washed and dried, but allowed to remain moist after nursing, particularly during the first few days, are also very apt to become macerated and cracked. In the cases in which there is a tendency for the breasts to "leak," the milk decomposes on the nipples, and the nipple becomes actually excoriated by the acids formed by the decomposition in the milk. Leaking nipples should be kept covered with pads of sterile absorbent gauze. Cracks and fissures in the nipple may be sufficiently painful to prevent a continuance of the nursing. In getting the histories of not a few bottle babies one is told that nursing has been stopped because of cracked nipples. A strong child tugging on a fissured nipple may occasion excruciating pain to the mother, and when the fissures are not healed, it can readily be understood that such pain and the dread of nursing may produce sufficient mental distress to change the character or stop the flow of the milk, either of which conditions may require that the nursing be discontinued. The prevention and successful treatment of the condition, therefore, is a matter of no little importance.

The treatment which gives the best results, and which has been in use at the New York Nursery and Children's Hospital, is to bathe the parts with a saturated solution of boric acid after each nursing, dry the nipple, and apply a pad of sterile gauze. Once or twice a day the cracks or fissures are painted with an 8 per cent. solution of silver nitrate. There is no pain attending this application. The pad of sterile gauze is placed over the nipple and held in position by a binder sufficiently tight to support the breasts. Before the nursing the nipple is bathed with sterile water and the infant takes the breast as usual. If there are deep fissures, it may be well for a day or two to use a nipple-shield (Fig. 2). The use of a light lead nipple-shield between nursings, particularly at night, has given good results in some cases, presumably from the formation of lactate of lead by contact of the shield with the moist nipple. Cleansing is essential after the use of this device. The use of an ointment on the nipples is not advised, for the reason that it is of little or no service, and in most cases ointments do actual harm because they soften the epithelium and make the nipple tender. Diminishing the number of nursings to three daily has been of use in some severe cases which were slow of response to treatment. Removing the child from the breast entirely is to be advised only under conditions of much urgency, as the milk may be entirely lost as a result of protracted absence of this stimulation to the breast.

Another important reason for securing rapid healing is the danger of infection through the open nipple wound, the usual cause of mammary abscess.

*Depressed Nipples.*—Not an infrequent source of difficulty in the management of the nursing function in a primipara are depressed nipples. The child cannot get a sufficient hold to make suction possible. He thus fails to get the desired nutriment, and, in consequence, both the child and the mother become exhausted. When this is repeated a few times, the child is very apt to refuse to make any attempt at nursing. In such cases the use of the nipple-shield is often indispensable until the nipple is sufficiently drawn out and developed for the child to get hold of. Preceding each nursing it is well to manipulate the nipple for a few minutes or to elongate it by the use of the breast-pump (Fig. 3), without using sufficient force to draw the milk.

*Caking of the Breasts.*—Induration of the breasts is of very frequent occurrence during the first few days of nursing. The milk, when it appears in the breasts, is often secreted in large amount. A great deal more is supplied than the child, with his small stomach and usually indifferent nursing, is able to digest. The breasts should therefore be watched very carefully during this time so as to guard against the possibility of the milk remaining undrawn. After the completion of the regular nurs-

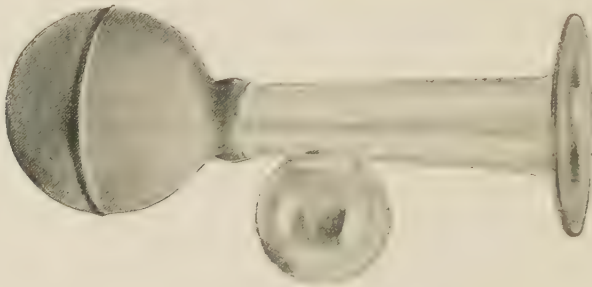


Fig. 3.—English breast-pump.

ing, if a considerable amount of milk remains in the breasts, it should be drawn by the breast-pump and the breast thus relieved.

Caking is frequently the outcome of fissured nipples. Sucking on the part of the child, the use of the breast-pump, and hard pressure in milking are all very painful procedures, with the result that the milk remains undrawn.

When nodules form, they may readily be softened by gentle massage. Lanolin should be used on the fingers so as to avoid unnecessary irritation of the skin. The massage should be repeated as often as the nodules appear. The caking is more apt to occur in the dependent portion of the glands. The so-called pendulous breasts, which may show a tendency to cake, should be supported by a binder tightly applied.

*Acute and Suppurative Mastitis.*—When inflammation of the breast develops with fever, chills, and prostration, it is usually the result of an infection through the nipple, generally one with visible cracks and fissures. For our purposes the different varieties of mastitis need not be considered. Nursing of the involved breast should be discontinued for the sake of both the child and the mother; in fact, the pain is often so great that nursing is impossible. A supporting bandage should be applied and

the milk drawn with the breast-pump at the usual nursing times. It must be our aim to induce resolution without the formation of pus. This is best accomplished by the use of an ice-bag which is applied to the inflamed, indurated area. If there is a tendency to constipation, saline laxatives should be used. In fact, the patient will often be benefited not a little by two or three watery evacuations daily. With a subsidence of the temperature and an abatement of the inflammation, nursing may be resumed. As soon as the presence of pus is determined, it should be removed regardless of its location in the gland. Many cases of intestinal infection in the infant, and of infectious processes in other parts of the body, have undoubtedly been due to nursing from suppurating breasts.

**Mixed Feeding.**—With a diminution in the amount of milk secreted, the breast milk must, of course, be supplemented by modified cow's milk. This method of feeding is usually successful. If the mother of a six-month-old baby can satisfactorily nurse him three times in twenty-four hours, he may be given, in addition, three bottle feedings, supplementing the mother's milk. It is best when using mixed feedings to alternate the breast and the bottle. The modified milk strength should be that which is suitable for the average child of the same age. (See General Rules, p. 73.) In beginning the use of cow's milk, however, it must be remembered that at first a weaker strength must be used than the child will require for growth, this weaker food being necessary in order gradually to accustom the infant to the change. If too strong a cow's milk mixture is given at first, it will be very apt to disagree, causing colic and vomiting. Later, when the child has become accustomed to the new food, a stronger mixture may be given. When a mother cannot give her infant at least two satisfactory breast feedings daily, it is advisable to wean the child.

**Maternal Conditions Under Which Nursing is Forbidden.**—When the mother has tuberculosis in any of its various forms or manifestations, whether it involves the glands, the joints, or the lungs, breast feeding is to be forbidden. In epilepsy and syphilis nursing is likewise forbidden. In nephritis and malignant disease of any nature, and in chorea, nursing should be discontinued. Women who are rapidly losing weight should not be allowed to continue nursing their infants. In most cases of serious illness, such as typhoid fever, pneumonia, or diphtheria, and upon the advent of pregnancy, nursing should be terminated.

It is the consensus of opinion of many authorities that when the mother is suffering from a mild attack of one of the infectious diseases, including pertussis, diphtheria, and scarlet fever, nursing may still be permitted. This rule does not apply in severe cases. Nursing babies rarely contract contagious disease from their mothers because the milk secretion undoubtedly conveys immunity.<sup>1</sup>

## WEANING

When is the nursing baby to be given other food, or how long can the breast be relied upon to furnish the sole nourishment? If the mother, unassisted, is able to nourish her infant completely for seven months, she

<sup>1</sup> Hartshorn, *Maternal Nursing*, New York Med. Jour., July 6, 1912.

is doing remarkably well. There are very few nursing mothers who can pass that period without assistance. Perhaps one or two bottle feedings a day may suffice. In many cases the milk will fail about the seventh month, and absolute weaning be necessary. Granting, however, that the child is thriving on the breast alone, or doing satisfactorily on the breast with only two daily feedings, at what age should the weaning take place? Just one mother out of several thousand came under our observation who could nurse her child to the child's advantage after twelve months had passed. Many pronounced cases of malnutrition, rickets, indigestion, and diarrhea have been the outcome of prolonged breast feeding.

The weaning in health should begin not later than the twelfth month, and in many instances it would be to the advantage of the child if nursing were interrupted earlier. Weaning is best accomplished gradually by substituting bottle feeding for nursing, giving only one bottle the first day, two the second, three the third, and so on until in a week or ten days weaning is complete. In case the child is ill we may be obliged to wean at once by substituting bottle feeding for the breast, but the milk formula corresponding to his age should not be given. A baby six months of age should receive the three-month formula; an infant nine months of age should receive the six-month formula. A gradual increase to the formula suggested for a child the age of the patient may be made if all goes well. After the ninth month it is often possible to feed from a cup, which is then to be preferred to bottle feeding as a substitute for the breast. It is best not to attempt weaning during the hot months unless the conditions demanding it are urgent.

**Care of the Breasts During Weaning.**—When the breast feeding is carried on the usual length of time—from nine to twelve months—the process of weaning ordinarily causes little or no discomfort. All that is usually required is to press out enough of the milk to relieve the patient as often as the breast becomes painful, which may not be more than two or three times a day. When the weaning is necessarily abrupt, no little discomfort may result. If there is a free flow of milk, which is apt to be the case when the weaning must take place in the early nursing period, tightly bandaging the breasts is required. When localized hardened areas occur in the glands, they should be massaged until softened, and the bandage reapplied and worn until the secretion ceases. When the weaning can be accomplished more gradually, the infant should have one less nursing every second or third day until only two are given daily. After this has been practised for one week nursing can be discontinued. In cases where sudden weaning is required, a saline laxative, such as citrate of magnesia or Rochelle salts, should be given every day for five days—sufficient to produce two or three watery evacuations daily. In the meantime the mother should abstain from fluids of all kinds up to the point of positive discomfort.

#### THE WET-NURSE

We are called upon to select a wet-nurse under various conditions. A few families, particularly those who have had disastrous feeding ex-

periences, ask that no attempts at artificial feeding be made, but that a wet-nurse be engaged in advance of the confinement so as to be ready when the time for her service arrives. Usually, however, our minds and those of the parents turn to the wet-nurse when nutrition by other means is a failure. It is well to remember in this connection that it is not wise to postpone our resort to the wet-nurse until every chance of her being of assistance has passed. It may take a few days' observation or but a single glance at one of these difficult feeding cases to decide whether a wet-nurse must be secured. Certain it is that in a few cases we cannot do without such aid.

In the selection of a wet-nurse the age during which nursing is most successfully carried on is to be remembered. As a rule a wet-nurse should not be under twenty-two or over thirty-five years of age. The peasant women of the continent of Europe make the best wet-nurses. A woman should not be selected as a wet-nurse without a thorough examination both of herself and of her infant. She must be free from skin diseases, tuberculosis, and syphilis. Whether she is stout or thin, tall or short, amounts to little. Neither can we place much reliance on the size of her breasts. Although full, firm breasts and prominent nipples are desirable, the best indication as to her nursing ability is the condition of her baby. For this reason it is best not to select a woman before her baby is four weeks old, for by that time his physical condition will indicate with considerable accuracy the kind of food he has been getting. The wet-nurse's milk need not correspond with the age of the patient for whom she is engaged, as breast-milk from the fourth week to the third month of lactation will answer for any infant.

The results attending the first few days of wet-nursing are often most disappointing. The radical change which takes place in the nurse's habits of life, necessitating the leaving of her own child to the care of others, sometimes produces nervous conditions which may have a decidedly unfavorable influence upon her milk. Before arriving at the conclusion that she will not answer in a given case she should, therefore, have time to adjust herself to the changed conditions. Many a good wet-nurse, accustomed to a very plain diet and some work, which necessarily means exercise, has been ruined, so far as her usefulness as a milk producer is concerned, by overindulgence at the table. Upon assuming her new office she is temporarily the most important member of the household next to the baby, and articles of food are supplied to which she is entirely unaccustomed and of which she eats plentifully. The result is an attack of indigestion with fever, the baby is made ill, and the usefulness of the wet-nurse in the family ceases. These women usually do best upon a plain diet of meat, poultry, fish, vegetables, cereals, and milk. If they are accustomed to taking beer, one bottle daily may be permitted. Coffee may be allowed to the extent of one cup daily, and of tea not more than two cups should be allowed. Women of this class are almost invariably neglectful of the bowel function, so that this must be attended to. One free evacuation should take place daily. As a rule, the wet-nurse has been accustomed to work and will be more contented and happy when her time is occupied. If she possess sufficient intelligence to take the baby for outings, she should be allowed to do so.

Being out of doors from three to four hours a day is of decided advantage to every nursing woman. For the comfort of the family it is wise not to let a wet-nurse know her full value. When she feels that she is indispensable, trouble is apt to follow. It is particularly necessary, therefore, that babies who are wet-nursed should be given one bottle feeding daily as soon as they are able to take care of it. The wet-nurse will then realize that she can be dispensed with in case of misconduct, or if she leave with an hour's notice the child can be given the bottle until another nurse is secured. In the great majority of cases it has not been necessary to continue the wet-nursing after the children are seven months of age, for by this time they can usually be fed on the bottle. Of course, unless her nursing proves unsatisfactory, a wet-nurse should not be dismissed at the commencement of or during the summer.

## ARTIFICIAL FEEDING

### THE PROBLEM

A considerable number of the young of the human race are deprived of the natural means of nutrition, the milk of the mother. For comparatively few is a wet-nurse available. While in proportion to the children born more mothers are nursing their infants now than formerly, nevertheless every year thousands of infants are brought into the world who have to be nourished by other means than human milk. The fact that an immense number of deaths occur every year among these infants because of defective nutrition speaks for itself.

**Nutritional Errors.**—Mortality statistics give a very inadequate idea as to the part played by nutritional errors in the young, for the reason that in many instances such errors are not the direct or immediate cause of death, and for this reason their influence does not appear in mortality statistics. As elsewhere pointed out, and dwelt upon at length in this work, in disease of any nature a child's resistance is a factor of paramount importance. With defective nutrition resistance is invariably below the normal. Many of the infants who die from the intestinal diseases of summer, from grip, from tuberculosis, or from infectious diseases, suffer from defective nutrition in different degrees of severity before the immediate cause of death exists.

**The Needs of the Patient Paramount.**—As nutrition deals directly with questions of life and death, it is not surprising that volumes have been written on the subject, but it is surprising that the fundamental principles of infants' nutrition are so little understood. This is due in part to the fact that writers and teachers of infant feeding, in their efforts to be scientific or ultrascientific, have lost sight of the point that there is a patient as well as a pupil to be considered, and that not a few teachers with their algebraic or otherwise intricate formulas do little but obstruct the progress of rational feeding by making a readily comprehended subject impossible to many. Another common error is in not distinguishing between children—the rich and the poor, the sick and the well. A baby with malnutrition, with marasmus, or with temporarily disordered digestion is by no means well, and when he is given food suitable only for the well, his condition very naturally is not improved.

**Environment.**--In feeding an infant, several predominant factors must be considered: First, the influences of environment. The infant in a children's institution has to be fed differently from one who comes to a dispensary for treatment, and both must be fed differently in summer than in winter. The child of well-to-do, intelligent parents is fed still differently. There are no hard-and-fast rules in infant feeding other than that there must be an ample supply of such nourishment as the child can digest and thrive upon. Cow's milk is used as the basis of infant's food, for the reason that it is ordinarily readily adapted to the child's digestion and is the most available substitute for human milk.

**Successful Artificial Feeding.**--Successful substitute feeding of infants consists, then, in giving something upon which the child can live and thrive, and when, in addition, this "something" supplies the nutrition which nature demands, it constitutes scientific infant food, whatever the source of the nutriment. Cow's milk is just as fully an unnatural food for an infant as is barley or rice gruel or the milk of the goat or the ass; and cow's milk only is used, as already mentioned, because in a great majority of cases it answers the given purpose better than does any other food, in that it furnishes in available form the nearest approach to the nutritional elements required.

### SCIENTIFIC INFANT FEEDING

The senior author was recently taken to task by a young colleague for using evaporated milk, malt soup, dextrimaltose, and various flours, such as barley and Imperial Granum, in feeding difficult cases. It was unscientific to use these substances, the argument maintained, because the human breast did not elaborate evaporated milk, malt soup, barley flour, or dextrimaltose. Instead of such substances, fresh cow's milk, lime-water, milk-sugar (Squibb's), and boiled water should be employed. The writer replied that he had used the substances enumerated daily for twenty-five years and had fed several thousands of infants on fresh cow's milk, milk-sugar, and lime-water; while in experience with many nursing mothers in institutions and in private work he could not recall a single instance wherein the human breast had secreted fresh cow's milk, lime-water, or Squibb's milk-sugar.

*Scientific infant feeding consists in supplying a balanced ration of fat, protein, carbohydrate, and mineral salts in an assimilable form upon which the infant makes normal development.* Neither the fat, protein, nor carbohydrate must be of one invariable form. Nature permits of a wide latitude.

In function, moreover, the fat and carbohydrate are interchangeable and may vary widely in nature and in quantity. There must, however, be a fairly definite content of protein of a nature that admits of its utilization; or we shall have varying degrees of malnutrition and marasmus; for without nitrogen and other protein constituents cell growth is impossible. By the use of starch and alkalis, the subjection of milk to the influence of heat of varying degrees, and by other means, we may change the nature of the protein to such an extent that the infant may utilize the food in a manner before impossible.

An immense amount has been learned concerning infant feeding during the past twenty-five years. Our scientific attainments, however, will be much greater after a few more decades, and even then the last word will not have been spoken.

### COW'S MILK

As cow's milk furnishes the most available basis of nutrition for the infant who is deprived of the mother's milk, it is essential in order to secure the best results from its use as an infant food, that it contain total solids between 12 and 13 per cent. and that the solids be represented in the nutritional elements in somewhat the following proportions:

Fat.....	3.5	to 4	per cent.
Sugar.....	4	to 4.5	"
Total protein.....	3.5	to 4	"
Ash.....	0.7	to 0.9	"
Specific gravity.....	1.028	to 1.033	

In order that the milk may be of a fairly constant strength, herd milk is to be preferred to the product of one or two cows, as the quality of the latter may vary considerably from day to day. It has been demonstrated that the best cows for this purpose are what are known as "grade cows," that is, not pure bred. Such cows thrive better, are more easily kept healthy, and are more uniform in the nutritional equivalent of their milk supply than are high-class registered herds of the Alderney or Jersey strain.

Milks necessarily differ in composition. The feeding of the cows and their care particularly influence the quality of the milk. The percentages given indicate approximately its nutritional value and are sufficiently accurate for purposes of feeding.

**The Fat.**—This ingredient of milk is in the form of a fine emulsion and separates as cream. Its character is affected by the cow's food, being softened when some articles are fed and hardened when other kinds of food are used. The fatty acids exist in a proportion about six times as great in cow's milk as in human milk. Furthermore, the emulsion of fat droplets is not so fine in cow's milk as in breast milk. These are two important facts explanatory of the ability of a nursing to digest 4 per cent. fat in breast milk when he may be incompetent to digest over 1.5 per cent. fat from cow's milk.

In the stomach the fat becomes entangled in the casein curds and undergoes very little digestion, leaving the stomach last of all the food elements, and, if given in too large amount even inhibiting to some degree gastric motility. In the intestines emulsification and saponification of the fatty acids into which the fats are split takes place in the medium of alkaline bile. The soaps on absorption are acted upon by the epithelium of the intestine and yield neutral fat which is taken up by the thoracic duct and eventually the blood. Rapid fat excretion is the rule in diarrhea. If, however, excessive fat in the intestine can be brought into combination with alkalies to form calcium soaps, constipation may result.

These are only a few of the considerations one must weigh in approaching the problem of fat per cent. determination for the given case.

**The Sugar.**—Ordinarily lactose is used because it is the sugar present

in breast milk. Because of the lower lactose content in cow's milk, an amount ranging from 6 to 4 per cent. must be added to modified milk feedings as the infant gradually increases his feeding capacity, in order to approximate the 7 per cent. sugar content of breast milk. As the whole milk proportion in the formula is raised, less sugar need be added. After absorption the sugar element circulates in part in the blood in concentration of 0.1 per cent. and is stored as glycogen not only in the liver but also in the muscles.

Reference to the selection of the individual sugars for different feeding requirements has already been made (pp. 20, 21).

**The Protein.**—In breast milk two-thirds of the protein is available in the form of soluble lactalbumin, whereas in cow's milk six-sevenths is in the form of casein, a kind of protein hard to digest and relatively poor in the essential amino-acid, cystin. This accounts for the relative ease with which the infant thrives on breast milk containing 1.25 per cent. protein, whereas, 1.75 to 2.50 per cent. protein is required from cow's milk to provide him with equivalent nitrogenous material necessary for growth. In terms of cow's milk  $1\frac{1}{2}$  to  $1\frac{3}{4}$  grams of protein is considered a fair allowance per pound of body weight, and since cow's milk contains 1 gram of protein per ounce we derive the simple feeding rule that protein requirements are fully met in terms of cow's milk by about  $1\frac{3}{4}$  ounces per pound of body weight.

The problem of modifying the casein to insure easy digestibility has been attacked in various ways to be described later.

**Examination of Cow's Milk.**—In the use of cow's milk, as in that of human milk, a chemical analysis is necessary in order to know accurately the nutritional elements. The specific gravity varies from 1.029 to 1.035. Milk is acid in reaction to phenolphthalein, and may be neutral to litmus. The Babcock milk-test machine is what is generally employed in examining cow's milk in laboratories and institutions. The test consists in mixing the milk with strong sulphuric acid, which dissolves the proteins and liberates the fat, the quantity of which is read off from the graduated neck of the bottle used in mixing the milk and acid. Only the fat is determined in this way. Knowing the fat and the specific gravity, one may readily determine the solids other than fat by adding to one-fourth of the specific gravity, reading to the right of the decimal point, one-fourth of the percentage of fat.

**Differences Between Human and Bovine Milks.**—The following comparison has been made by Morse and Talbot.<sup>1</sup>

	Human milk.	Cow's milk.
Fat.....	4.00	4.00
Sugar.....	7.00	4.75
Protein.....	1.50	3.50
Salt.....	0.20	0.70

“Both are amphoteric in reaction when they leave the breast. Cow's milk is usually acid when it reaches the baby. Human milk is practically sterile as the baby takes it. Cow's milk, even under the best conditions, is far from sterile when the baby gets it. The emulsion of the fat is much finer in human milk than in cow's milk. The proportion of fatty acids

<sup>1</sup> Diseases of Nutrition and Infant Feeding, 1915, p. 182.

is much higher in cow's milk than in human milk. A large proportion of the protein in human milk is in the form of whey protein. A large proportion of the protein in cow's milk is in the form of casein. Human milk is not coagulated by commercial rennin, cow's milk is coagulated. Both are coagulated by human rennin. The enzymes of the two milks are different and each milk has a specific serum reaction.

"It is evident, therefore, that no matter how cow's milk is modified, it will still be different from human milk. The percentages of the different food elements can be made the same. The difference in the protein can be corrected by the use of whey. The emulsion and the composition of the fat will, however, always be different. The ferments can never be made the same and the specific serum cannot be changed."

**Bacteriology of Cow's Milk.**—Milk fresh from the udder contains very few bacteria, particularly if the first two or three jets from each teat are discarded. The time for bacterial contamination is during the milking and while the milk remains in the stable. Certain forms of bacteria are harmless, and it is impossible to have a milk absolutely free from bacteria. What we need to know is how dangerous bacteria get into the milk, and how they cause changes that may convert it into a poison of greater or less virulence.

*Harmless Bacteria.*—The souring of milk is the result of the presence of bacteria, which produce changes in the sugar of milk, with the formation of lactic acid. Of these, *Bacillus acidi lactici* and *Streptococcus lacticus* are the common forms. The "turning" of milk during a thunder-shower is due to certain changes in the atmosphere that aid in the development of the bacteria which convert lactose into lactic acid.

*Harmful Bacteria.*—Bacteria of decomposition, under conditions favorable to their growth, attack the protein constituents of the milk, producing putrefactive changes with evolution of poisons which may be of the greatest virulence. The putrefactive bacteria are always present in stables where manure is allowed to collect and where cleanliness is not observed. When we remember what a culture-field milk affords to bacteria, and when we see the manure and the surroundings in which milk is usually drawn, it is not surprising that the milk should contain many millions of bacteria to a cubic centimeter. They may enter the milk from the dust in the stable—a very fruitful source—or they may find entrance from the milker's hands or from droppings of fine particles of manure from the belly of the cow. Bacteria from these sources are among the most dangerous forms found in milk.

Among diseases readily transmitted through contaminated milk are to be mentioned tuberculosis, typhoid fever, scarlet fever, diphtheria, and septic sore throat.

The organisms of dysentery, cowpox, hydrophobia, actinomycosis, foot-and-mouth disease, the staphylococcus, gas bacillus, colon bacillus, cholera bacillus, and anthrax bacillus are all at times found in milk.

**Market Milk.**—The legal standards for pure milk in most instances relate only to the chemical composition of the milk. The laws of most of the States call for 12 per cent. of total solids, and at least 3 per cent. of fat. If the milk contains less than these percentages it is considered impure, even if it is just as it was when it left the cow's udder. Some

cows give milk considerably below this standard. The chemical analysis of milk does not show whether it is suitable for use as an infant food, this point being decided according to its freshness and the care with which it has been handled with reference to the exclusion of bacteria and the prevention of their growth. The production of clean, safe milk is expensive without allowing anything for the labor of caring for the cows. The milk must be carried to the consumer, which is also expensive. Yet, in New York City milk that satisfies the legal requirements retails in the grocery stores, during the summer months, at 10 or 12 cents a quart. This milk is known as "grocery milk," or loose milk, and is a very poor food for infants. It is teeming with bacteria, as little care is taken in its preservation.

The next grade of milk is sold in quart bottles which have been filled in the country, packed in cracked ice, and shipped to the city. The milk contains many bacteria, but is far better than grocery milk. It is retailed to the consumer in two grades, at a difference of about 3 cents in cost. *Grade A* milk must contain not over 30,000; and *Grade B*, not over 100,000 bacteria per cubic centimeter.

*Certified Milk.*—The best grade of milk, and the one which should be used in feeding infants whenever possible, is known as "certified milk," and is produced under the direction of what is known as a "milk commission." The establishing of "milk commissions" in different cities throughout the country has been the means of securing a much better milk supply than was formerly possible, and has unquestionably been instrumental in saving thousands of lives. To Dr. H. L. Coit, of Newark, N. J., is due the credit of organizing the first milk commission.

Certified milk must conform to certain standards as to its nutritional value and as to the number of bacteria per cubic centimeter. These standards are established by a committee of medical men who compose the milk commission, and who have complete control of the dairy and its entire output.

The Milk Commission of the New York County Medical Society requires a standard of milk not containing over 10,000 bacteria in a cubic centimeter. When a dairyman has shown to the satisfaction of the Commission that he can produce a milk up to the required standard, he is allowed to attach to his bottles labels certifying to that fact. Milk thus "certified" is taken from the delivery wagon from time to time and subjected to examination by their bacteriologist in order to determine whether it conforms to the requirements of the Commission. Certified milk, furthermore, must contain an average of 4 per cent. butter fat and must be obtained from tuberculin-tested, tuberculosis-free cows.

A study of the details that must be observed in the production of such milk is most instructive and gives insight into the best methods of dairy management. Suffice it, however, to state that certified milk containing fewer than 5000 bacteria per cubic centimeter is now a common commodity and is obtainable by a steadily increasing number of families.

**Sterilization and Pasteurization of Milk.**—The sterilization and pasteurization of milk, as the terms imply, are for purposes of preservation. The term *sterilized milk* is applied to milk that is heated to the boiling-point and maintained at that temperature—212° F.—for twenty min-

utes. The effect of sterilization is the destruction of the pathogenic bacteria, but it will not destroy the spores. Dr. R. G. Freeman's observations

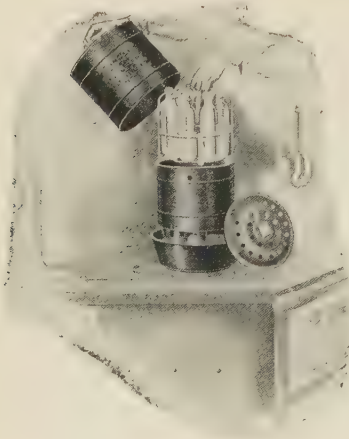


Fig. 4.—Arnold sterilizer.

show that heating the milk to 140° F. and maintaining it at this point for one hour is of advantage, in that the bactericidal effects are as good as when a higher temperature is used. At the same time the lower temperature produces less chemical change in the milk. *Pasteurization* consists in heating the milk to 167° F., maintaining it at that temperature for thirty minutes, and then quickly cooling it. The effect of sterilization and the rapid cooling is to kill the existing bacteria, thus preventing, temporarily, further bacterial growth in the milk.

The milk which is boiled in a bottle which is properly covered is "sterilized milk," but if the sterilization is to be carried on day after day an

Arnold sterilizer (Fig. 4) should be used. For purposes of pasteurization the Freeman pasteurizer (Fig. 5) is recommended. Pasteurization makes



Fig. 5.—Freeman pasteurizer.

less change in the character of the milk content; consequently, there is less interference with its nutritive value. The temperature, too, 167° F., is sufficiently high to destroy pathogenic bacteria, including *Bacterium*

lactis aërogenes, and hence acts as a valuable preservative, particularly during hot weather.

*Pasteurization Safest for Exclusive Use.*—The question, whether milk should be given sterilized, pasteurized, or raw has given rise to endless discussion in the press and in medical societies. Each method has its advocates. Among the pediatricists at the present time some contend that milk should be sterilized, regardless of the season of the year, the character of the milk, or the station in life of the patient; others maintain that invariably it should be given raw, regardless of the above-mentioned conditions; while still others are devoted to pasteurization. If any of the methods were to be used exclusively, pasteurization, being the safest, should be selected. Judging from varied experience in the matter of the heating of milk for infant foods, the subject should be considered from a broad standpoint. There is no one way of heating milk that is invariably the best. There are several factors which determine which is the proper procedure in a given case.

*Raw Milk Preferred if Fresh and Pure.*—There is no doubt whatever that the less the milk is heated, the better food it is for the average well baby, provided it is clean when procured and can be kept clean and sweet until it is used. (See Cow's Milk, p. 60.) This is possible in some of our dairies of the better class; it is possible with many who live in the country, or who go to the country for the summer and who keep their own cows or who get their milk supply from a neighboring source which they can control. Under such conditions the milk may be given raw during the entire year.

When, however, the milk has to be shipped a considerable distance during the summer, when its safety depends upon the industry and carefulness of the employees of a milk farm, pasteurization is advisable during the heated term. Sterilized milk is rarely used among our private patients except during an ocean journey (see Milk for Traveling, p. 96) or a long-distance journey by land. For hospital out-patients the following scheme is the safest: From May 1st until October 1st the milk is boiled (sterilized). These people, most of them, cannot afford a pasteurizer or sterilizer or understand the use of either. From October 1st to May 1st the milk is given raw. Pasteurization would be preferable, but it is possible with but very few dispensary patients. Even the giving of cooked milk, which unquestionably often becomes contaminated after cooking, is attended with no little risk to the child, as is shown by the death records of bottle babies during the summer. The giving of the cheap market milk raw to infants of the tenements during the heated term in any large city can only help to increase the mortality of this season.

The object of heating the milk should always be explained to the mother so that she may appreciate the necessity of keeping it carefully covered and properly caring for it afterward. The idea is prevalent among uninformed people that after sterilization but little further protection is required. When one is satisfied the out-patients have not the requisite intelligence nor the means for keeping cow's milk during the summer, such as an ice-box and ice, he may discontinue the ordinary milk feeding for the hot months and use evaporated milk instead (p. 78).

**Cream.**—Market creams are known as “gravity cream” and “centrifugal cream.”

*Gravity cream* is obtained by allowing the milk to stand for a certain length of time and then removing the cream. When milk, as soon as it is drawn, is placed in a quart milk bottle or fruit jar and kept at a temperature of between 40° and 50° F., most of the fat will have risen at the end of five hours. When the cream is carefully removed at the end of this time, from 0.3 to 0.8 per cent. of fat will remain in the milk. The fat content of gravity cream is subject to considerable variation, depending, of course, upon the richness of the milk and the manner in which it is treated, particularly as relates to rapid cooling. In cream from well-kept grade cows the fat will average about 16 per cent. In cream from well-fed Alderney or Jersey herds it may be as high as 20 per cent. or higher. In cream from cows indifferently fed, or those which subsist entirely upon poor pasturage, the fat may be as low as 10 or 12 per cent. For infant feeding gravity cream from the milk of grade cows is preferred. In using cream for infant feeding all the cream to the milk line should be removed, as the upper layers are much richer in fat than that adjoining the milk. Further, when cream is mixed with milk both must be of the same age, as the addition of older, bacteria-laden cream to fresh milk will surely result in grave digestive disorders.

*Centrifugal cream* is that which is removed by an apparatus known as a separator, which consists of a circular bowl for holding the milk, so arranged as to make from 3000 to 5000 revolutions a minute. This results in a rapid separation of the lighter fat from the milk. The fat collects near the center of the bowl and is removed by a device arranged for this purpose. The skimmed milk flows outward from another portion of the bowl by a similar device. Centrifugal cream is more difficult of digestion than gravity cream, in that the natural emulsion in which the fat is held in the milk is destroyed by the process of centrifuging. Centrifugal cream may vary greatly in its fat content, depending upon the rapidity of operation of the separator. According to Babcock and Russell the proteins also undergo a change which does not add to their nutritive value.

The skimmed milk derived in the manner described contains a remnant of 0.5 per cent. fat.

#### THE ADAPTATION OF COW'S MILK

At one time it was thought that, by changing the percentage composition of cow's milk and altering the reaction, it could be made practically identical with human milk, and the term “modified milk” was applied to cow's milk so manipulated. A great variety of manipulations of cow's milk has been introduced, which often differ greatly in the principles involved. Yet to products of all these different manipulations the term “modified milk” is applied. It may mean any one of a dozen or more different products. Cow's milk diluted with water and given as a food to an infant is called “modified milk.” When sugar, cereal gruel, lime-water, bicarbonate of sodium, or citrate of sodium is added, the mixture is still “modified milk.” When a prescription is sent to the laboratory calling for definite amounts of fat, sugar, and protein the product furnished is “modified milk.” When a mother is

told to use a definite amount of cream, milk, sugar, and water, "modified milk" is also the outcome.

As a matter of fact, successful infant feeding consists in what should be termed "milk adaptation," that is, modifying the milk to suit the case in hand. The routine prescriber is content to prescribe "modified milk" which is a simple imitation of human milk. The best-informed prescriber uses "an adapted modified milk."

**The Percentage Standard.**—To Rotch, of Boston, we are indebted for the establishment of the practice of thinking in percentages in the feeding of infants. The method based on the fact that the proportion of fat, sugar, and protein in average breast milk is fairly indicative of the needs of the normal infant, is employed as a means of varying formulæ for individual patients.

Working with cream and skimmed milk each of known composition one may add varying amounts of milk-sugar and construct mixtures of any desired composition. Slight increase or diminution in any of the different elements may also be made with control over the rearrangement of the proportions of the constituents.

Sufficient variation in the percentages of the protein and fat for practical feeding purposes may be similarly obtained by diluting top milk from different levels after the natural separation of cream on standing. Formulæ illustrative of this point are to be found on pp. 70, 71.

To reduce any given formula to the percentages of its constituents one may simply multiply the percentage of the respective elements in the original undiluted milk by the proportion of the milk in the total formula. For example, a formula containing 10 ounces of milk of the composition fat 5 per cent., protein 3.50, and sugar 4.50, with water up to 30 ounces, will without the addition of the usual supplementary sugar contain 10/30 of each of the percentages given for each ingredient, *i. e.*, 1.66 per cent. fat, 1.16 per cent. protein, and 1.5 per cent. sugar. Adding 1½ ounces of sugar to the 30-ounce mixture will increase the sugar content by 5 per cent., thus making the total sugar percentage 6.5.

The practice of thinking in percentages is easy to acquire and of undoubted value.

**The Calorimetric Standard.**—In brief, the calorimetric standard is based upon the amount of energy indicated in calories for each pound of body weight. A calorie is the amount of heat required to raise the temperature of 1 liter of water 1° C.

Heubner, of Berlin, several years ago began the employment of calorimetric principles in infant feeding. His original observations, which were made on healthy breast-fed infants, weighed before and after each feeding, showed that under six months 100 calories were required daily for every kilogram of body weight. After the sixth month, the number of calories required gradually lessened, so that at the completion of one year about 85 calories to each kilogram of body weight appeared to be necessary.

Lamb<sup>1</sup> reduced Heubner's figures to pounds. He gave the calorimetric requirements during the first three months of life as 45 calories daily per pound of body weight, during the next three months from 40 to 45 calories

<sup>1</sup> Archives of Pediatrics, June, 1908.

daily per pound, decreasing gradually during the next six months, so that at the twelfth month from 32 to 35 calories daily per pound of body weight are necessary.

Heubner's observations, upon which the standard is based, were made on thriving breast babies. In order to judge of its practical value in artificial feeding the histories of 33 bottle-fed infants were selected at random, from office files, for investigation. It was found that every child was getting food of greater caloric value than the standard called for. All but 2 required food in caloric value exceeding 100, as set by the standard. The daily consumption of 31 of these splendidly thriving infants, all of whom continued to do well, was from 140 to 360 calories in excess of the Heubner standard. Only 33 histories were investigated.

Hundreds of records are available showing the same result. The calorimetric standard is thus a means of little utility in infant feeding. It may aid as a check to excessive feeding of very young and delicate infants. Infants whom we see—and they differ not at all from the average infants in this country—cannot be fed successfully by this method alone.

As the factors of absorption, body length, surface area, and rate of metabolism are studied the limitations of the application of the calorimetric standard to infant feeding are being better understood. (See pp. 22-24.)

**Milk Modification.**—The analysis of mixed dairy milk shows it to contain approximately:

4.0 per cent. fat.  
4.0 per cent. sugar.  
3.5 per cent. total protein.

Human milk contains approximately:

4.0 per cent. fat.  
7.0 per cent. sugar.  
1.5 per cent. total protein.

The first aim in the modification is to make the chief nutritional elements in the food prepared from cow's milk correspond grossly to the nutritional elements in the human milk. The protein must be reduced, the sugar increased, and the fat reduced even slightly below that usually found in mother's milk, as the child's digestive capacity for cow's milk fat is less by from 15 to 25 per cent. than it is for human milk.

The *protein* element in an infant's food is its chief nutritional content. This has to be reduced to approximately the proportions that exist in human milk, and the change can be accomplished only by dilution. The diluent may be plain water or it may be a cereal gruel.

If 8 ounces of milk is mixed with 8 ounces of water, we get a pint mixture with an approximate nutritional equivalent of:

2.0 per cent. fat.  
2.0 per cent. sugar.  
1.75 per cent. total protein.

If 4 ounces of milk is mixed with 12 ounces of water, we have a 16-ounce mixture with an approximate nutritional equivalent of:

1.0 per cent. fat.  
1.0 per cent. sugar.  
0.9 per cent. total protein.

If 6 ounces of milk is mixed with 10 ounces of water, a 16-ounce mixture is produced with an approximate nutritional equivalent of:

1.5 per cent. fat.  
1.5 per cent. sugar.  
1.3 per cent. total protein.

By this simple dilution with water the desired protein content of the food may be arrived at.

*The Sugar.*—For nourishment of an infant, however, the mixture is weak in fat and very weak in sugar. The sugar content is increased by the addition of milk-sugar or cane-sugar. It will be remembered that in human milk there is a sugar content of 7 per cent. The combination of full cow's milk and water as above gives a sugar content of 2 per cent. or less, so that sufficient sugar must be added to make the increase approximately 7 per cent. What is necessary, then, is to increase the sugar content 5 per cent. A 1 per cent. sugar and water mixture would contain approximately 5 grains of sugar to the ounce. A 6 per cent. sugar mixture would contain 30 grains to the ounce, and as our dealings are with a 16-ounce mixture, we require an addition of 16 times 30 grains of sugar-of-milk, or 480 grains, so that if we direct that a pint mixture contain 6 ounces of a 4-4-3.50 milk, 10 ounces water, 1 ounce milk-sugar, there would be an approximate nutritional equivalent of:

1.5 per cent. fat.  
7.5 per cent. sugar.  
1.3 per cent. total protein.

Or if the mixture were 4 ounces of milk, 12 ounces of water, 1 ounce of milk-sugar, there would be an approximate nutritional equivalent of:

1.0 per cent. fat.  
7.0 per cent. sugar.  
0.9 per cent. total protein.

It is convenient to remember that 1 ounce of sugar added to any 20-ounce mixture increases the sugar content 5 per cent.

*The Fat.*—While a child of from two to four months might thrive on the above formulæ, the fat is obviously deficient and must be increased. This may be accomplished by the use of cream. Cream of the same age as the milk should be used. When this method of feeding is carried out, in order to secure a suitable cream, a quart bottle of milk from a mixed herd of grade cows is allowed to stand at a temperature of 40° or 50° F. for five hours, when a cream which has been referred to as *gravity cream* will be produced of the approximate strength of:

16.0 per cent. butter-fat.  
3.2 per cent. sugar.  
3.2 per cent. total protein.

With milk, cream, and sugar-of-milk food of every possible strength may thus be obtained.

This method of milk preparation is more accurate than when top milk mixtures are used, but it has the disadvantage of requiring 2 quarts of milk for the twenty-four-hour feeding period, one to supply the milk

and the other the cream, all of which must be removed and mixed before any of it is used in the food. It is unnecessary to go into the details of the cream and milk mixture method.

A more satisfactory method of obtaining any desired fat percentage consists in the appropriate dilution of various top milk portions with water. By this procedure after the gravity cream has formed in the manner described a convenient number of ounces supplying the desired fat content for dilution is removed from the top of the quart bottle with a Chapin dipper and the desired fat percentage is obtained usually by the use of a single quart of milk.

The *fat content of various milk portions* from one ordinary quart bottle (provided the milk is allowed to stand at a temperature not over 50° F. for five hours after milking) is as follows:

Portion.	Fat, per cent.
Top 5 ounces .....	20
Top 10 ounces .....	10
Top 16 ounces .....	7
Top 20 ounces .....	6
Top 25 ounces .....	5
Bottom 28 ounces .....	2
Bottom 24 ounces .....	1

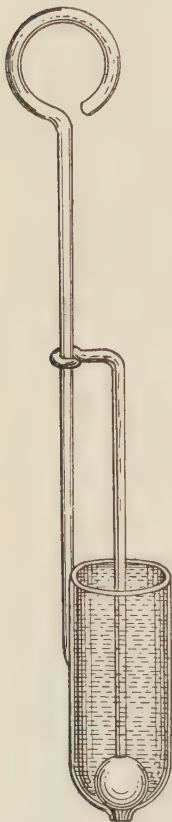


Fig. 6.—Self-filling and emptying Chapin dipper.

In all of the samples, for purposes of feeding, the protein and sugar content may be considered the same as in whole milk.

By using the appropriate top milk for dilution it is thus possible to vary the fat as desired without appreciable change in the protein and sugar percentages selected on the basis of the customary whole milk dilution. For example: A top 12-ounce portion diluted with twice its volume of water may afford a desired 3 per cent. fat. If such dilution reduces the protein content below the percentage desired in a given case the use of a top 16-ounce portion diluted with less water per given volume of milk will supply more protein without exceeding the desired 3 per cent. fat.

**Top Milk Mixtures.**—In adaptation by the use of top milk the milk is first allowed to stand in a quart bottle at a temperature of 45° to 50° F. for five hours. The quantity needed is then removed from the top of the bottle with a Chapin dipper (Fig. 6) and diluted as desired with water or gruel to which sugar-of-milk and lime-water are added. The value of the lime-water will be considered under the "Use of Alkalies and Antacids," p. 75. The milk selected should be the cleanest obtainable from grade cows; usually the most expensive is the best.

From a quart bottle of milk on which the cream has risen, dip from the top with a Chapin dipper 16 ounces and mix. From average milk this should contain:

7.0 per cent. fat.  
3.2 per cent. sugar.  
3.2 per cent. total protein.

The following formulas are suggested for the various ages:

*From the Third to the Tenth Day:*

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	6 ounces	
Lime-water	$\frac{3}{4}$ ounce	Fat. . . . . 1.75
Milk-sugar	1 $\frac{1}{2}$ ounces	Sugar. . . . . 6.6
Boiled water to make	24 "	Total protein. . . . . 0.8

Seven feedings in twenty-four hours; 2 to 3 ounces at each feeding.  
One ounce = 12.5 calories.

*From the Tenth to the Twenty-first Day:*

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	7 $\frac{1}{2}$ ounces	
Lime-water	2 "	Fat. . . . . 1.75
Milk-sugar	2 "	Sugar. . . . . 6.8
Water to make	30 "	Total protein. . . . . 0.8

Seven feedings in twenty-four hours; 3 to 4 ounces at each feeding.  
One ounce = 14.2 calories.

*From the Third to the Sixth Week:*

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	10 ounces	
Lime-water	2 "	Fat. . . . . 2.2
Milk-sugar	2 "	Sugar. . . . . 7.0
Water to make	32 "	Total protein. . . . . 1.0

Seven feedings in twenty-four hours; 3 to 4 ounces at each feeding.  
One ounce = 16 calories.

*From the Sixth Week to the Third Month:*

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	12 ounces	
Milk-sugar	2 "	Fat. . . . . 2.6
Lime-water	2 "	Sugar. . . . . 7.2
Water to make	32 "	Total protein. . . . . 1.2

Seven feedings in twenty-four hours; 4 to 5 ounces at each feeding.  
One ounce = 17.5 calories.

*From the Third to the Fifth Month:*

After this age two bottles of milk are required, 16 ounces being taken from the top of each bottle and mixed. At this time a cereal jelly is usually added to the food.

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	18 ounces	
Milk-sugar	2 "	Fat. . . . . 3.15
Lime-water	3 "	Sugar. . . . . 6.4
Water to make	40 "	Total protein. . . . . 1.4

Six feedings in twenty-four hours; 5 to 6 ounces at each feeding.  
One ounce = 18.3 calories.

*From the Fifth to the Seventh Month:*

		Approximate Percentage Equivalent.
Milk (top 16 oz.)	21 ounces	
Milk-sugar	2 "	Fat. . . . . 3.50
Lime-water	3 "	Sugar. . . . . 6.4
Water to make	42 "	Total protein. . . . . 1.6

Five to six feedings in twenty-four hours; 6 to 7 ounces at each feeding.  
One ounce = 19.6 calories.

After the fifth month it is desirable to add from 1 to 3 teaspoonfuls of a cereal jelly to each feeding. This may be added to the milk

mixture when it is made in the morning. Thus, if 1 teaspoonful is to be given at each feeding, where a child is getting six feedings, 6 teaspoonfuls of the jelly may be added to the entire quantity.

*From the Seventh to the Ninth Month:*

			Approximate Percentage Equivalent.	
Milk (top 16 oz.)	27	ounces		
Milk-sugar	2½	"	Fat	3.9
Lime-water	3	"	Sugar	7.0
Water to make	48	"	Total protein	1.8

Five feedings in twenty-four hours; 7 to 8 ounces at each feeding.

One ounce = 21.7 calories.

*From the Ninth to the Twelfth Month:*

			Approximate Percentage Equivalent.	
Milk (top 16 oz.)	35	ounces		
Milk-sugar	2½	"	Fat	4.3
Lime-water	4	"	Sugar	6.5
Water to make	56	"	Total protein	2.0

Five feedings in twenty-four hours; 8 to 9 ounces at each feeding.

One ounce = 22.4 calories.

After the twelfth month plain undiluted cow's milk may be given with the cereal jelly in addition to the other articles of diet suggested for a child one year old. (See p. 135.)

Considerable latitude is allowed as to the amount of food which may be given at each feeding, because of the difference in the capacity and requirements of individual children. The well child of average size and weight will require daily about 30 ounces of a suitably adapted food at the third month, 30 to 40 ounces at the sixth month, and 40 to 45 ounces at the ninth to the twelfth month.

*Night Feedings.*—After the third month the midnight feeding should be discontinued. Six feedings are sufficient, the first at 6 A. M. and the last at 10 P. M.

Between 10 P. M. and 6 A. M. the child should sleep. Babies are easily weaned from the night bottle by substituting a bottle of boiled water or a milk mixture greatly diluted with water. The child soon discovers that this is not worth waking for. As a result of a full night's rest the digestive organs are better able to do their work, the appetite is increased, and a larger amount of food may be given at each feeding.

*The Quality of Milk Variable.*—It is not claimed that the nutritional value as indicated by the percentage equivalents in the above series is absolutely correct. Milks necessarily differ in composition. Only mixed dairy milk is referred to, the product of several grade cows. The feeding of the cows and their care also influence the quality of the milk. The percentages given indicate approximately the nutritional value and are sufficiently accurate for purposes of supplying satisfactory nutrition to well babies of the various ages. The fat will not be found too low for proper nutrition in any of the formulæ given. It may be too high for proper digestion and require adjustment. The proteins as given are sufficient for nutrition if they are assimilated.

**General Rules for Computing Formulæ.**—Volumes of set formulæ applicable to well and sick babies have been written in the past and the list of top milk feedings above given might easily be supplemented by

many more lists, were it not that the tradition for multiplicity of computations has been sufficiently upheld by writers in the past. It is only essential for the student to reserve for his guidance certain simple rules. Those presented at the New York College of Physicians and Surgeons may, in part, be cited. (The method employs whole milk dilutions, but is readily extended to the use of top milk of known composition.)

The *daily fluid requirement* of the infant is about 2 ounces per pound weight for the first two weeks, and 3 ounces during the early months, decreasing to 2 ounces again by the end of the first year.

The *amount of the individual feeding* based on the figures for anatomic and physiologic capacity is about  $\frac{1}{2}$  ounce per pound of body weight.

The *caloric requirement* of the average healthy infant during the first two weeks is from 25 to 35 calories per pound, from two weeks to six months 45, and after six months a little less.

The *protein requirement* is fundamental. It ranges from  $1\frac{1}{4}$  to  $1\frac{3}{4}$  grams per pound of body weight. Since 1 ounce of cow's milk contains 1 gram, the protein necessary for an infant is supplied by a number of ounces of cow's milk equivalent to the number of grams of protein indicated in a given case.

The *fat requirement* for a normal infant will have been met by an amount contained in the whole milk in about the same proportion as the protein.

The *sugar requirement* ranges from 4 to 7 per cent. To most dilutions of milk for feeding 4 or 5 per cent. of carbohydrate should be added.

In writing a feeding formula in terms of a whole milk mixture for a normal infant the rules cited are applicable in detail as follows:

1. Total volume fluid equals the body weight in pounds  $\times$  3 to 2.
2. Number of feedings equals 7, 6, or 5 according to age.
3. Number of ounces per feeding equals  $\frac{\text{Total volume of food in ounces}^1}{\text{Number of feedings.}}$
4. Total calories needed equals body weight in pounds  $\times$  45 to 40.
5. Protein requirement equals body weight  $\times$  protein of  $1\frac{1}{2}$  to  $1\frac{3}{4}$  ounces of milk.
6. Caloric value of the milk protein equals number of ounces taken  $\times$  21 (for convenience, 20).
7. Balance of caloric allotment to be supplied by added carbohydrate equals in ounces  $\frac{\text{Calories required minus calories in milk}}{100 \text{ to } 120 \text{ depending on caloric value of 1 ounce of the form of carbohydrate used.}}$
8. Volume of diluent equals total volume minus volume of milk portion.

#### Example:

Child three and a half months—weight 13 pounds.

1. Total volume =  $13 \times 2\frac{1}{2}$  =  $32\frac{1}{2}$  oz.
  2. Number of feedings = 6
  3. Ounces per feeding =  $\frac{32\frac{1}{2}}{6}$  =  $5\frac{5}{12}$ . (Take  $5\frac{1}{2}$ .)
  4. Calories needed =  $13 \times 45$  = 585.
  5. Protein requirement =  $13 \times 1\frac{3}{4}$  =  $22\frac{3}{4}$  oz. milk. (Take 23.)
  6. Calories in milk =  $23 \times 21$  = 483 (roughly  $23 \times 20 = 460$ ).
  7. Ounces of sugar to be added =  $\frac{585 - 483}{120}$  =  $\frac{5}{6}$  oz. (roughly  $\frac{585 - 460}{120} = 1$  oz.)
  8. Diluent to be added =  $33 - 23$  = 10 oz.
- The formula would therefore read:
- 23 ounces whole milk.
  - 1 ounce of sugar.
  - 10 ounces of water.
  - $5\frac{1}{2}$  ounces at each of six feedings.

<sup>1</sup> If there is a small fraction in quotient take nearest half-ounce.

For undernourished babies a rough guide as to the proper allowance for caloric requirements is the mean between the actual weight of the patient and the weight of a normal infant of the same age.

*Example:*

A child at nine months weighs 10 pounds.

A normal infant at this age weighs about 18 pounds.

The weight figure on which to base food estimation is 14.

It has now been shown how by appropriate dilution, and by the addition of sugar the chief nutritional elements in cow's milk may be made to correspond roughly with those of human milk; the protein being reduced, the sugar increased, and the fat reduced slightly below that usually found in human milk in order to meet the child's digestive capacity, which is 15 to 25 per cent. less for cow's milk fat than for human milk fat.

The problem of altering the character of the milk to meet special needs remains to be considered, and this brings us to the details of milk modification.

**The Effect of Heating Milk Upon Its Assimilation.**—Concerning the treatment of milk in order to make it easier of utilization we have much to learn. The milk proteins lend themselves to influences which entirely change their character, and affect their utilization by the infant. The heating of milk influences its digestibility and heating with different substances produces further changes in this respect.

As previously stated, evaporated milk is easily and effectively utilized by the infant with a very weak digestive system, and this milk has been subjected to a heating process.

When one studies the data available for explanation of the beneficial effects clinically observed as a result of the use of boiled and evaporated milk he meets with disappointment, because the changes demonstrated in milk which has been heated do not all make for its easier digestibility. The mineral salts largely undergo precipitation. The casein is rendered less easy of coagulation by the digestive fluids, but is softer and lighter than in raw milk. The lactalbumin is precipitated and forms a portion of the scum on the surface of the heated milk, which entangles a portion of the fat. The fatty acids are in part volatilized. Prolonged heating may caramelize a portion of the sugar.

While the bactericidal effects of heating are in the main beneficial, certain putrefactive spore-bearing organisms may remain after heating and spoil the milk before it turns sour, as it ordinarily does from the action of viable lactic acid organisms before the putrefactive protein changes occur.

The antiscorbutic vitamin is destroyed by heating.

These, in brief, are the principal changes, their completeness depending largely on the degree and duration of the heat applied.

In addition, the boiling of milk with cereal furthers the subdivision of the casein and secures a protective colloid action of undoubted benefit in the digestive canal.

**Boiled Milk.**—A certain child cannot take fresh cow's milk, modify and adapt it as we will. We give him evaporated milk of the same nutritional value and he thrives. The digestive ferments are unchanged and

the food capacity remains the same; the change that takes place is in the most important of the milk constituents, the protein. The degree of heat used and the length of its application also have a controlling influence on the digestibility of milk. The most favorable effects are apparently produced through heating milk in the presence of starch and then adding an alkali or antacid.

For example, an infant suffering from malnutrition is given a formula of—

- 10 ounces milk (top 15).
- 1 ounce milk-sugar.
- $\frac{1}{2}$  ounce barley flour.
- 20 ounces water.
- 10 grains bicarbonate of soda.

The food agrees to the extent that the child is comfortable, but he fails to make a substantial gain. He gains and loses an ounce or two weekly. We now order that the milk and the barley be cooked together in a double boiler for thirty minutes and that water be added at the completion to make up for that which passes off in evaporation. The food is given in the same amount at the same interval, and at once the child begins to take on weight. The feeding schemes have been identical excepting that in the latter we have added heat. Such an outcome will not take place in all cases, yet this effect has been demonstrated time and again.

Repeatedly, when an infant has been brought for treatment of malnutrition and found to be taking a rational cow's milk formula, the food strength has been continued as it was with the simple substitution of starch and malt soup for the original milk-sugar or dextrimaltose; the new carbohydrate portion being mixed together with the milk and cooked for thirty minutes in a double boiler. The same carbohydrate content has been maintained, the food has been given in the same amount and at the same interval. Following this, the record repeatedly has shown prompt and continuous gain in weight.

*Frozen Milk.*—During the past thirty years many thousand quarts of frozen milk have been fed to infants under the senior author's care. In no instance has it been demonstrated that frozen milk was the cause of illness. There is, therefore, little reason for the belief that milk which has been frozen disagrees with the average bottle-fed baby.

Furthermore, little experimental evidence has been elaborated on this point indicating any very definite changes in the composition of milk in freezing.

Nevertheless many pediatricians make it a rule to boil all milk that has been frozen, ascribing otherwise unexplained diarrheal attacks to neglect of this practice.

**The Use of Alkalies and Antacids.**—The casein of human milk when it enters the infant's stomach separates into small, flocculent masses. Cow's milk entering the infant's stomach, without an addition of an alkali or other modifying medium, is precipitated by the pepsin in the stomach and forms a heavy curd, consisting of paracasein, which fails of digestion or assimilation, and at which the child's stomach often rebels. The adaptation of the casein of cow's milk to the child's digestive capacity, so as to maintain suitable nutrition, is a central point around which

the whole subject of infant feeding revolves. It will be noted in the formulas for cow's milk feeding that lime-water is used as a diluent. This is used not simply to dilute the milk nor to render it alkaline, as has frequently been stated, but also to prevent the coagulation of the casein and the resulting formation of tough curds of paracasein. Simple dilution with water may make a smaller curd, but does not produce the flocculent character peculiar to human milk that follows the addition of alkalies and antacids to cow's milk. In the presence of an alkali the casein does not combine with the acid in the stomach; consequently the resulting acid coagulation does not take place. For this reason alkalies and antacids are added to cow's milk. Usually the additions are too small.

Poynton, of London, has advocated the use of citrate of soda with a view to preventing the solid coagulation of the casein. It is claimed that by using citrate of soda, 1 grain to the ounce, sodium paracasein is produced, which is a fluid. Citric acid is liberated and unites with the calcium, forming the citrate of calcium, which is absorbed.

Signs of indigestion of the casein in the milk are usually pain and discomfort. There are usually acute attacks of colic. There may be constipation, or diarrhea alternating with constipation, associated with the passage of many hard curds in the stools, the patient losing steadily in weight. In such instances the best means of adaptation consists in reducing the amount of protein to a total of 1 per cent. by dilution with water, and the addition of sufficient alkali, such as lime-water, bicarbonate of soda, or citrate of soda, to form a curd more readily attacked by the digestive juices. One who feeds many infants will not be fully in accord with the belief, which is now fashionable, that the casein of cow's milk is a factor of no importance in its adaptation.

**Whey Feeding.**—Whey mixtures may be of temporary use. In whey the casein is largely removed—about 0.3 per cent. remaining. Analyses of whey show a nutritional equivalent of about:

0.5 per cent. fat.  
0.9 per cent. lactalbumin.  
0.3 per cent. casein.  
4.5 per cent. sugar.

As whey is ordinarily made, it is impossible to obtain a lower percentage of casein than 0.25. The amount of casein will oftentimes reach 0.5 per cent. unless it is heated and strained a second time. The deficiency in fat may be overcome by adding gravity cream p. 66 of the same age as the milk from which the whey is obtained, in the proportion of 1 or 2 ounces to a pint of whey. This, of course, carries with it a very small amount of casein, which may make a total beyond the child's digestive capacity. Low protein must be given only during acute illness or indigestion, and should be a diet for temporary purposes until the child is able to care for more suitable nourishment.

**Adaptation Through Peptonization.**—When a child has incapacity for cow's milk to such a degree that he is not able to take milk properly diluted and given at suitable intervals, peptonization may often aid us, although we have frequently been sorely disappointed in its use. Theoretically, peptonization—the predigestion of the food—should be a

solution of many digestive problems. Its efficiency in actual use may be learned from mortality statistics of children under two years of age in large cities, an immense proportion of the deaths being due either primarily or secondarily to nutritional errors. Not every infant, of course, is given peptonized milk; but if it possessed the value claimed for it by some of its advocates, the demand would be such as to compel its universal use, and difficult feeding cases would be no more.

In using peptonized milk the protein strength should be reduced to 1 per cent.—the lowest point compatible with safety. The amount and intervals of feeding should correspond with those suggested for the age of the patient. The following method has served best: Fifteen minutes before nursing the bottle is removed from the ice and from one-eighth to one-fourth of a tube (Fairechild's peptonizing tube), depending upon the amount of milk in the bottle, is added. The bottle is then placed in water sufficiently heated—110° to 120° F.—to make it the right temperature for a child at the end of ten minutes. The degree of the temperature of the water must of necessity vary according to the temperature in the bottle and the amount to be heated. So-called complete peptonization produces a product with a decidedly bitter taste, which few children will take.

This form of milk in which there is a complete conversion of the casein has been most useful in two types of cases:

*For Gavage.*—During acute or chronic illness when a child cannot take food by the natural method, as in diphtheric paralysis, or when he will not swallow on account of an acute inflammatory disease of the throat, such as peritonsillitis, retropharyngeal abscess, or retropharyngeal adenitis, or when he is in a comatose condition from any cause except intestinal infection, the feeding of completely peptonized milk by gavage (p. 853) is of inestimable value.

*For Nutrient Enema.*—In conditions when stomach feeding is impossible either by gavage or the natural method—conditions met with in persistent vomiting due to acute cerebral diseases, in recurrent vomiting, in acute gastric indigestion—and as an accessory means of feeding when sufficient nourishment cannot be taken by the stomach, the colon feeding of completely peptonized, skimmed milk has a decided field of usefulness. Feeding children by the bowel, however, is usually possible for a few days only, because of the local irritation produced by the nutriment and by the passage of the tube. Skimmed milk, peptonized, with the addition of the white of egg makes the best nutrient enema for such cases (p. 98). It should be given at a temperature between 90° and 95° F. at from six- to eight-hour intervals. The tube should be introduced at least 9 inches. In cases of recurrent vomiting, repeatedly both hunger and thirst have been relieved by feeding in this way.

**Adaptation by the Use of Cereal Gruels.**—It is claimed by many excellent observers that the use of cereal gruels causes a mechanical division of the casein, and it is thus more readily acted upon by the digestive juices. While we use gruels largely as milk diluents, and frequently as milk substitutes, we have yet to be convinced that in difficult feeding cases they possess any great value in the adaptation of milk to the child's digestive capacity, unless given in sufficient concentration

to change the consistency of the food. They are valuable adjuncts to the diet in cases in which weak milk foods must be given, but we do not recall an instance in which we thought the use of a stronger casein possible because of the cereal-water diluent. One who has fed gruels as diluents in a large number of cases for years will have had abundant opportunity to see enormous curds vomited and passed by the rectum by children on a milk and gruel diet in spite of test-tube demonstrations representing the process of curdling which takes place in the stomach and showing a minute division of the curd when the milk is treated with gruels. The advantage of a cereal diluent lies in the fact that a greater amount of food is thereby given, the starch often being tolerated better than sugar.

**Malt-soup Feeding.**—The use of malt-soup extract offers a most satisfactory method of making cow's milk assimilable.

The chief use of this food is in malnutrition cases of slow-growing infants who, though not actually ill, fail to show a satisfactory growth. In treating bottle-fed infants who suffer from colic and marked constipation due to casein incapacity this food has also considerable use.

The milk strength considered suitable for the condition and age of the child may be used. Lime-water is not employed because of the presence of carbonate of potash in the malt soup. The maltose and flour, a considerable portion of the latter having been dextrinized, take the place of other carbohydrates in the mixture.

The milk and flour mixture, strained and added to the solution of malt soup and water, should be placed over a slow fire and "simmered" for thirty minutes with constant stirring. Excess of malt soup may produce vomiting, so that any increase should be made with caution.

**Condensed and Evaporated Milk.**—In not a few cases the feeding of fresh cow's milk, manipulate it as we may, is impossible. For such cases another breast milk substitute is available, a cow's milk product in which a portion of the water content has been removed by evaporation at a low temperature.

Condensed milk is in the market in three forms—*fresh condensed milk* sold in bulk, *condensed milk to which cane-sugar is added*, sold in hermetically sealed cans, and *evaporated milk* without the addition of sugar, sold in hermetically sealed cans. The best known and most readily available brands are Borden's condensed milk, known as the Eagle Brand, and Borden's evaporated milk, known as Unsweetened Evaporated Milk. The Eagle Brand contains cane-sugar in considerable amount, and is rarely to be used. The unsweetened brand is evaporated milk without the addition of sugar. In the condensing process the milk is heated to 200° F. It is then transferred to vacuum pans, where it is maintained at a temperature of 125° F. until sufficient water is evaporated to bring the product to the required condensation.

The analysis of the Eagle Brand is as follows:

Fat.....	9.5	per cent.
Sugar.....	54.67	"
Total protein.....	7.84	"
Ash.....	1.68	"
Water.....	27.31	"

The analyses of unsweetened evaporated milk and the unsweetened condensed milk sold in bulk are very similar. The standard maintained is as follows:

Fat.....	8.3	per cent.
Sugar.....	10.05	"
Protein.....	7.1	"
Ash.....	1.43	"
Water.....	73.07	"

The above products are respectively typical of numerous other condensed and evaporated milks on the market, the percentage figures showing the composition of the different products being remarkably similar.

Sweetened condensed milk (*e. g.* Eagle Brand) by reason of its high sugar content is to be fed in dilutions of about 1 to 8, or a dram to the ounce of water. In the nutrition of young infants with a good sugar tolerance the value of this brand of condensed milk is probably greatest.

In using milk of this type for feeding that known on the market as *evaporated milk* is to be preferred. A fresh can must be opened daily. The fact that the evaporated milk is free from added sugar makes possible the feeding of a larger amount. One part of the milk to 3, 5, 6, or more parts of diluent may be used. Thus, the formula for a day's food would read like the following:

7 ounces evaporated milk.  
 28 ounces water.  
     carbohydrate {starch} {starch,  
                           {sugar} {malt-soup extract.  
 10 grains bicarbonate of soda.

Milk of this strength affords a nutritional value of 1.66 per cent. fat, 1.43 per cent. protein, 2.01 per cent. sugar. To this mixture carbohydrate in the form of starch, cane-sugar, dextrimaltose, milk-sugar, or malt-soup extract may be added to raise the total carbohydrate to 6 or 7 per cent. If malt soup and starch are used, cooking will be required. (See Malt-soup Feeding, p. 78.) More or less of the evaporated milk may be used as may be required. Many infants of very weak digestion will thrive on the evaporated milk thus given when all other artificial methods fail. To the very young, and those with poor digestive capacity, and to athreptics, a lesser amount of milk may be given at first—1 part of milk to 7 or 8 of diluent—the quantity being increased as the infant shows improved capacity.

As the child grows older and increases in weight the amount of evaporated milk may be increased. We have never given a stronger formula than 14 ounces of the unsweetened evaporated milk, 26 ounces water, carbohydrate to 6 or 7 per cent. The weight chart (Fig. 7) shows the progress made by a child on this scheme of feeding. Notes on the chart indicate when the evaporated milk feeding was begun and the various strengths used. Previously the child had been given various fresh cow's milk formulæ.

In not a few cases the food seems to be better assimilated if the entire mixture—milk, starch, and sugar—is kept just under the boiling-point in a double boiler for thirty minutes. Occasional stirring is neces-

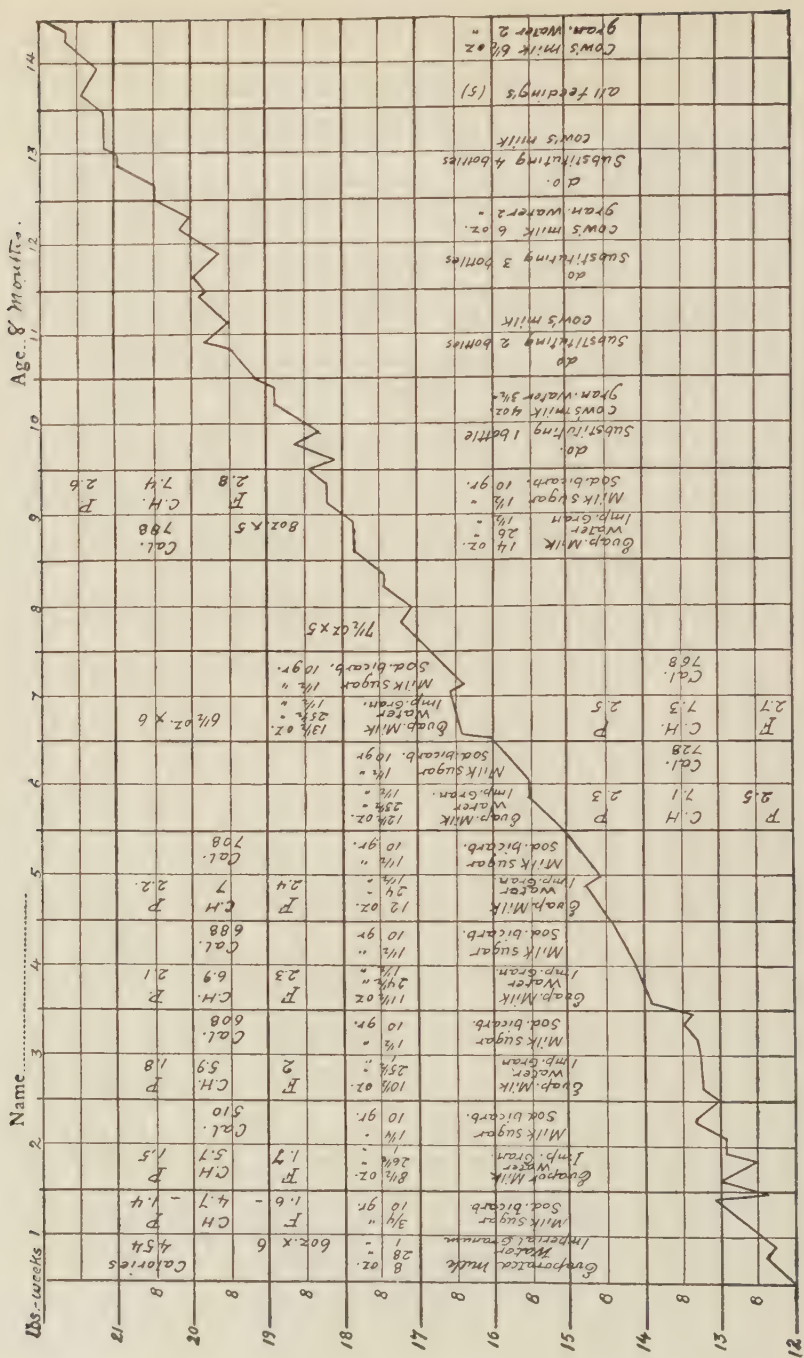


Fig. 7.—Chart showing progress made on evaporated milk. Food value indicated in percentages and calories.

sary, and at the completion of the heating process water should be added to bring the food to the original amount.

When the child has remained comfortable for six to eight weeks or

longer on such feeding, almost always with a gain in weight, one feeding daily of a plain milk mixture may replace a feeding of condensed milk. A raw milk mixture should always be given in weaker strength than the child's age calls for. In spite of the dilution it may occasion indigestion, colic, and the passage of curds. In such an event the evaporated milk and its diluent must again be the sole diet for two or three weeks; then the use of ordinary milk may again be attempted. After a few days or a week, in case one such feeding is taken without inconvenience, a second feeding may replace another evaporated milk feeding. In this way the number of plain milk feedings may be gradually increased until the child is taking a rational diet of this milk alone.

*Illustrative Case.*—A six-month-old baby took daily three feedings of condensed milk and three of raw milk. Attempts were made to give him the fourth feeding of raw milk, but invariably with disastrous results. He was slightly under weight, but in a fair general condition.

We have successfully managed a great many of these difficult feeding infants, as described above, withholding ordinary milk feeding until the child is taking the evaporated milk well and gaining, then gradually advancing the raw milk feeding until, when the child is five or six months old, he is taking daily and assimilating two or three feedings of the fresh milk. When six months old, and sometimes earlier, he may be given suitable raw milk feedings exclusively. By the above method the desired end of complete plain milk feeding is reached sooner than when small quantities of cow's milk are added to the evaporated milk mixture.

In beginning, it is best to give the raw milk at the first or second feeding in the morning, when the digestive powers are stronger than they are later in the day. When the second raw milk feeding is given, it should never immediately follow the first. The raw milk and the evaporated milk should be alternated until more than one-half of the daily feedings are of fresh milk.

If this method has to be used for a considerable period it is best to give 2 or 3 teaspoonfuls of orange juice daily. A convenient time to use the orange juice is one hour before the second feeding.

#### FORMULÆ FOR EVAPORATED MILK FEEDING

##### *From the Third to the Tenth Day:*

Milk, evaporated.....	2 ounces
Lime-water.....	$\frac{1}{2}$ ounce
Milk-sugar.....	1 "
Boiled water.....	$17\frac{1}{2}$ ounces

One ounce = 10 calories.

Seven feedings in twenty-four hours; 2 to 3 ounces at three-hour intervals during the day and four-hour intervals at night.

##### *From the Tenth to the Twenty-first Day:*

Milk, evaporated.....	3 ounces
Lime-water.....	$1\frac{1}{2}$ "
Milk-sugar.....	$1\frac{1}{2}$ "
Boiled water.....	$19\frac{1}{2}$ "

One ounce =  $12\frac{1}{2}$  calories.

Seven feedings in twenty-four hours; 2 to 3 ounces at three-hour intervals during the day and four-hour intervals at night.

*From the Third to the Sixth Week:*

Milk, evaporated.....	5	ounces
Lime-water.....	2	"
Milk-sugar.....	2	"
Boiled water.....	25	"

One ounce =  $13\frac{3}{4}$  calories.

Seven feedings in twenty-four hours; 3 to 4 ounces at three-hour intervals during the day and four-hour intervals at night.

*From the Sixth Week to the Third Month:*

Milk, evaporated.....	6	ounces
Lime-water.....	3	"
Milk-sugar.....	2	"
Boiled water.....	26	"

One ounce =  $13\frac{5}{8}$  calories.

Seven feedings in twenty-four hours; 4 to 5 ounces at three-hour intervals during the day and four-hour intervals at night.

*From the Third to the Fifth Month:*

Milk, evaporated.....	7½	ounces
Lime-water.....	3	"
Milk-sugar.....	2	"
Boiled water.....	29½	"

One ounce =  $13\frac{1}{2}$  calories.

Six feedings in twenty-four hours; 5 to 6 ounces at three-hour intervals during the day and a feeding at 10 p. m.

*From the Fifth to the Seventh Month:*

Milk, evaporated.....	10	ounces
Lime-water.....	3	"
Milk-sugar.....	2	"
Boiled water.....	29	"

One ounce =  $15\frac{1}{3}$  calories.

Five feedings in twenty-four hours; 6 to 7 ounces at four-hour intervals, the last feeding at 10 p. m.

*From the Seventh to the Ninth Month:*

Milk, evaporated.....	11	ounces
Lime-water.....	3	"
Milk-sugar.....	2	"
Barley water.....	35	"

One ounce =  $16\frac{1}{3}$  calories.

Five feedings in twenty-four hours; 7 to 9 ounces at four-hour intervals, the last feeding at 10 p. m.

*From the Ninth to the Twelfth Month:*

Milk, evaporated.....	12	ounces
Lime-water.....	3	"
Milk-sugar.....	2	"
Barley water.....	34	"

One ounce =  $17\frac{1}{2}$  calories.

Five feedings in twenty-four hours, 8 to 9 ounces at four-hour intervals, the last feeding at 10 p. m. Nine ounces is the maximum amount that should be given a baby at one time.

The foregoing formulæ may require changing to suit the individual case. If the formula seems to produce indigestion, an ounce of the milk may be removed and an ounce of the water substituted. If the formula agrees, but the child is not satisfied, the formula may be increased by adding an ounce of milk and removing an ounce of water.

In arranging formulæ for the different ages, it is assumed that the child is of average weight and vitality. Very small, delicate children may at first require reduction in the milk strength and a lesser amount at each feeding.

**Dry Milk Preparations.**—Preparations of dry milk powder from which the moisture has almost completely been removed have during the past few years come into general use. In the sense that these preparations are as yet in the hands of a few concerns and are dissimilar in composition depending on their source, they are to be regarded as proprietary foods. The principles of their use are identical, however, and their application to infant feeding may be taken up at this point.

Dry milk is prepared by two chief methods. By one the milk is sprayed into a heated chamber in the form of a fine spray which is at once condensed to a powder falling to the floor of the chamber like fine snow. By the other process the milk is instantaneously dried by flowing over hot revolving cylinders. In most of the preparations the fat content is kept low to insure better keeping of the product. The advantages of dry milk are its ready transportability, its stability, its cleanliness, its convenience to the consumer in the ready preparation of food.

Dry milk probably has its greatest value in the feeding of small infants whose capacity for finely divided casein is good, but whose fat and sugar tolerance is low. The protein element in this type of food may often be raised above the proportion customary in feeding without symptoms of indigestion resulting, and the gains in weight thus attained are often spectacular, particularly when an infant getting an inadequate breast-milk supply is given supplementary dry milk feeding. In not a few instances, however, after a fortnight or more of favorable progress such an infant will begin to show signs of protein intolerance, the first of which is often a strongly ammoniacal urine productive of excoriation of buttocks. If food is longer continued, even with admixture of alkali, gastric indigestion and diarrhea may be induced. In such instances substitution of weak evaporated milk feeding for a time is often beneficial.

Dry milk filled a particular field of usefulness during the war as a food for infants in countries where fresh milk was unobtainable.

The various preparations of *malted milk* contain in most instances maltose and dextrin in addition to dry milk. The tabulation given (p. 93) includes a number of these complex foods. In the main they are applicable to cases in which the sugar tolerance is not diminished and have no advantage over dry milk to which appropriate carbohydrate is added.

**Cereal Gruels; Starch Feeding.**—Much discussion has taken place during the past few years concerning the use of cereals in infant feeding.

The cereals consist of plant embryos surrounded by a mass of highly nutritious proteins and carbohydrates in the form of starch, which nourishes the embryonic plant until it becomes rooted in the ground. As the developing plant needs nourishment it converts the starch into dextrin and maltose. Cereals are analogous to eggs in that the germ is packed away in a supply of exceedingly nutritious food, which in the process of development it converts into tissue. Almost all of the prepared infant foods are made from cereal flours with or without the addition of a little dried milk or sugar, or from cereals in which the starch has been transformed into dextrin and maltose. The proprietary meal foods, which consist of baked flours of different kinds, are useful aids in infant feeding and most useful as milk substitutes when milk must temporarily be withheld. The conversion of starch into dextrin by the

baking process is so slight that it may be ignored. Robinson's barley flour, Cereo Co.'s barley flour and the other gruel flours, and Imperial Granum (baked wheat flour) require boiling before use. They may be prepared according to the instructions given in the formulary (p. 95).

It is customary in bottle feeding to begin with a cereal by at least the fifth to the seventh month, by using a cereal water as a *diluent of the milk mixture*. For this purpose barley or granum is usually employed. Very often in out-patient work we begin with a cereal diluent very early in life in order to *make the food mixture more nutritious*. This method of feeding is useful when accurate modifications are not possible and when the child for any reason cannot take a milk formula as strong as age and nutritional requirements demand. Such cases are frequently seen in the marasmic, the malnutrition, and the difficult feeding class. The addition of 2 or 3 tablespoonfuls of flour to the daily food will increase its nutritive value not a little. That boiled starch may be digested by the youngest and most marasmic infant has been proved.

The principal use of these flours, however, is in the treatment of gastro-enteric diseases, where cereal may with safety replace the milk for considerable periods of time. By eliminating milk from the diet and giving carbohydrates, a putrefactive culture-field is removed and a less favorable soil is furnished for the development of the pathogenic types of intestinal bacteria; further, there are no by-products formed to produce intestinal toxemia or kidney irritation. Two even tablespoonfuls of these flours to 1 pint of water give approximately a food strength of 0.07 per cent. fat, 0.3 per cent. protein, 2 per cent. carbohydrate. In order to increase the nutritive value, sugar may be added in sufficient quantity to bring the carbohydrate percentage up to 5. The addition of the sugar also makes the cereal more palatable, and therefore more acceptable to the patient.

During an invasion of scarlet fever, pneumonia, or any of the illnesses of childhood which may be accompanied by great prostration, the usual foods, whatever their nature, should be withheld, and the cereal gruel, alone or mixed with chicken or mutton broth, used as a very satisfactory substitute. Likewise later in the disease it is never well to give full milk while fever and prostration are present. Cereal gruels are especially serviceable as diluents of the milk in conditions where this combination must often furnish the nutrition for a period of days.

The use of the baked-flour gruels, with sugar or without, as a means of nutrition should be continued only during the active symptoms of the disease, whether it is scarlet fever or one of the intestinal diseases. In no sense are these gruels advocated as exclusive foods for infants or for growing children. This error has been made with most disastrous results.

*The Infant's Capacity for Starch Digestion Proved by Experiment.*—It has been claimed with more or less tenacity by different writers that the young infant possesses no capacity for starch digestion. That the youngest infants may digest starch is now definitely established. The experiments of Moro, Zwiefel, Corwin, Hess<sup>1</sup> and Kerley<sup>2</sup> have proved the earlier beliefs erroneous.

<sup>1</sup> Amer. Jour. Dis. Child., October, 1912.

<sup>2</sup> Kerley, Mason, and Craig, Arch. Ped., July, 1906.

**Concentrated Cereal-milk Mixtures.**—*History.*—In 1911 Hahn<sup>1</sup> reported good results from the administration of 5 to 6 per cent. grits in milk in such form that 1 liter represented 1000 calories. McClure<sup>2</sup> reported the case of a neurotic vomiting infant who promptly ceased vomiting when fed thick barley gruel for which thick farina and milk was later substituted. Sauer<sup>3</sup> applied the method, which he elaborated individually, to 12 cases of pyloric obstruction with striking success in 11 cases, and a year later Porter<sup>4</sup> reported similar success with 10 pyloric cases. Mixsell<sup>5</sup> applied thick cereal feeding successfully to cases of malnutrition dependent on vomiting, and Current and Durand<sup>6</sup> extended its use to breast-fed babies with colic.

Thick cereal feeding is therefore no longer to be regarded as a radical experiment, but rests upon an established basis. Representative case histories together with a more detailed review of the literature are available in a report by Graves.<sup>7</sup>

One of the patients in his series who had a complete breast milk intolerance took a cereal mixture readily from a spoon beginning at one week of age.

*The Method.*—The feeding of concentrated cereal in milk is based on the simple physical behavior in the stomach of a paste as opposed to a liquid. The liquid in vomiting cases, particularly those dependent on pylorospasm is rejected with a spurt or gush while the cereal paste mass containing more food in smaller bulk distends the stomach less, apparently has some soothing effect on the irritable gastric mucosa, and eventually induces pyloric relaxation which permits of the passage of gastric contents provided no true organic closure of the pylorus exists.

"The cereal of choice is probably farina, because of its property of great expansion under cooking, thus permitting thickening of the mixture with a minimum amount of added starch. Three or 4 tablespoonfuls in a 20-ounce formula will ensure sufficient solidification by the time cooking has reduced the quantity one-third, although greater concentration may at times be advisable. Obviously the amount of water to be used is not arbitrary. Skimmed milk, evaporated milk, dry milk powder, or breast milk may be incorporated in preference to whole milk. Sugar of any form may be employed, but should be maintained at a low percentage until tolerance is proved, with due regard for the possible ill effect of maltose when vomiting is a chief symptom. For an infant under six months of age an allowance of 2 or 3 tablespoonfuls at a feeding ordinarily suffices. If more is demanded the indication is for a thicker rather than a larger feeding.

"The calorie guide is more valuable than the percentage method in calculating the ration. Empirically it has been found that 60 to 75 calories per pound of body weight may be required to maintain a satisfactory gain, and that a larger allowance may be demanded and tolerated.

<sup>1</sup> Med. Klin., 1911, 7, 1452.

<sup>2</sup> Amer. Jour. Dis. Child., 1914, 7, 48.

<sup>3</sup> Arch. Ped., July, 1918, 385.

<sup>4</sup> Ibid.

<sup>5</sup> Arch. Ped., August, 1919, 449; August, 1920, 486.

<sup>6</sup> Northwest Med., October, 1920, 240.

<sup>7</sup> The Role of Concentrated Cereal-milk Mixtures in Early Infancy, Amer. Jour. Med. Sci., April, 1922, clxiii, 576.

"The importance of starch-free stools is likely to be magnified. Complete starch digestion is, of course, advantageous, but if incomplete digestion of the starch gives rise to no concomitant colic, distention, or hiccup the method may be continued with appreciation that the cereal is at least serving as a good vehicle.

"Water between feedings is desirable, but not at all times necessary."<sup>1</sup>

For further discussion of the application of this method to the treatment of vomiting the reader is referred to p. 218.

**Butter-flour Feeding.**—The butter-flour feeding of Czerny and Kleinschmidt<sup>2</sup> is prepared by gently heating 4 level tablespoonfuls of ordinary salt butter in a pan until foaming occurs, and the odor of volatile fatty acids has disappeared (three to five minutes). To this is added 5 level tablespoonfuls of fine wheat flour. Again the mixture is heated with constant stirring until the mass is thin and brown (three to five minutes). Then 20 ounces of water in which 3 level tablespoonfuls of sugar have been dissolved is added. The mixture is then boiled and rubbed through a fine sieve. The percentage constitution of this stock solution is fat 5.75 per cent., carbohydrate 10 per cent., protein 0.5 per cent., providing 26.6 calories per ounce.<sup>3</sup> To this stock solution cow's milk is added in quantities dependent on the weight and requirements of the child.

The following directions constitute a guide:

For a child under 6½ pounds, use 2 parts stock solution and 1 part milk; for example:

Stock solution (prepared as above), 12 ounces.....	Fat, 4.6 per cent.
Cow's milk, 6 ounces.....	Carbohydrates, 8.2 per cent.
Seven feedings in twenty-four hours.....	Protein, 1.5 per cent.
2½ ounces at each feeding.....	24.6 calories per ounce

For an infant over 6½ pounds, use 3 parts stock solution and 2 parts milk. For example an 8-pound child failing to gain should receive:

Stock solution (prepared as above), 15 ounces.....	Fat, 4.6 per cent.
Cow's milk, 10 ounces.....	Carbohydrates, 7.8 per cent.
Seven feedings in twenty-four hours.....	Protein, 1.7 per cent.
3½ ounces at each feeding.....	24.3 calories per ounce

For larger children the proportion of milk is increased as, for example, for a child of 11 pounds:

Stock solution (prepared as above), 17 ounces.....	Fat, 4.9 per cent.
Cow's milk, 17 ounces.....	Carbohydrates, 7.0 per cent.
Seven feedings in twenty-four hours.....	Protein, 2 per cent.
4 to 5 ounces at each feeding.....	24.4 calories per ounce

Because of the high caloric value per ounce, it is usually best not to feed more than 3 to 4 ounces per pound of body weight in twenty-four hours, water being given separately. High caloric feedings, 75 to 90 calories per pound, are well borne.

The stools produced by this type of feeding are bright, glistening and yellow with a pungent aromatic odor, similar to that of breast-milk stools.

<sup>1</sup> The Rôle of Concentrated Cereal-milk Mixtures in Early Infancy, Amer. Jour. Med. Sci., April, 1922, clxiii, 576.

<sup>2</sup> Czerny and Kleinschmidt: Jahrb. für Kinderheilk., 1918, lxxvii, 1.

<sup>3</sup> Griffith and Mitchell, New York Medical Journal, August 3, 1921.

Butter-flour feedings are especially indicated for children who have good stools, and do not vomit, but fail to gain properly on other rational feedings.

Czerny and Kleinschmidt consider it most important that the relation of butter to flour by weight be 1 : 1.

**Buttermilk and Lactic Acid Milk.**—As ordinarily prepared buttermilk is a skimmed milk preparation of a composition approximately as follows:

Fat.....	0.5 to 2	per cent.
Lactose.....	3 to 4	"
Protein.....	3 to 4	"
Lactic acid.....	0.5 to 0.75	"

This composition varies, depending on whether the buttermilk is prepared from skimmed milk, whole milk, or cream.

The advantages of such food are its low fat percentage, its comparatively low sugar percentage, and its relatively high protein content which comprises more than the usual proportion of soluble albumin together with casein in a finely divided form which cannot be acted upon by rennin.

As ordinarily prepared buttermilk is soured naturally and contains not only the lactic acid organisms largely responsible for the souring, but various other bacteria certain of which may be pathogenic. It is more rational to use prepared lactic acid milk than ordinary buttermilk, not only because of the bacterial factor involved but also because the composition of prepared lactic acid milk may be controlled more readily.

*Preparation.*—Lactic acid milk is ordinarily prepared artificially by adding 1 or 2 of the commercial lactic acid tablets, such as the Lactone tablet of Parke, Davis & Co., to fresh milk at room temperature and allowing it to stand over night, the principle being the same as that employed in the East in making ordinary Bulgarian sour milk with a "starter" portion obtained from the milk of a previous day. Sterilization of the milk before the artificial souring is not necessary if the milk is known to be fresh and clean. Such sterilization delays the action of the lactic acid organisms.

A simple scientific method of preparing lactic acid milk that readily commends itself was worked out by Sherman and Lohnes.<sup>1</sup> Taking advantage of the known facts that the fine clotting desired in the milk occurred at an acidity point of 60 as measured by decinormal sodium hydroxid, and that when the acidity reached 170 to 190 fermentation spontaneously ceased, these authors simply allowed the milk selected to ferment for twenty-four hours in a warm place in the usual manner and then diluted the product with boiled milk in equal amount, thus cutting down the acidity to below 95. This acidity still being above 60 insured the clotting of the added milk after which the mixture was kept on ice.

These and other investigators have employed corn syrup extensively because of its cheapness and the character of its sugar to supplement the lactic acid milk in the feeding of infants whose sugar tolerance permitted. Surprisingly large amounts of sugar in a lactic acid medium have

<sup>1</sup> Jour. Amer. Med. Assoc., October 2, 1920.

been taken even by very young and underweight infants with resulting improvement in stools that had previously been putrefactive, and rapid gains in body weight.

Undoubtedly the good effects of lactic acid milk are in part due not only to the lactic acid itself, but to the contained organisms which tend to discourage the growth of a putrefactive intestinal flora. Surprisingly good results, however, are obtained by the simple addition of lactic acid to whole milk in the proportion of 1 dram to 1 pint.<sup>1</sup>

**Protein Milk.**—This preparation is designated also as albumin milk, Eiweissmilch, and Finkelstein's milk. Its use was developed by Finkelstein and Meyer and has long been a matter of routine in hundreds of institutions. Variations in the process of making this food are responsible for much of the disagreement which still exists respecting its value. For this reason we have selected Lowenburg's description of Finkelstein's method of preparation<sup>2</sup> as a reliable guide: "A teaspoonful of any milk coagulant, as rennin or pepsin, is added to 1 liter of whole milk. This is thoroughly mixed and the vessel containing the material is placed in a water-bath the temperature of which is about 110° F. This raises the milk to about 100° F. Within a short period coagulation occurs and the entire mixture becomes solid. The mass is then incised by a complete crucial incision. This facilitates the escape of the whey. The coagulum is now placed in a suspension bag (made of either four or five layers of cheese-cloth or of a porous material resembling thin, unbleached muslin) for a period of four hours. This permits all the whey to escape, carrying with it the major portion of the salts and the sugar of milk. The tough curd is then pushed through a hair-mesh sieve in order to completely comminute it. This process is accomplished with a wooden spoon, or drug-gist's pestle, or with a wooden instrument resembling a potato masher. It is repeated four or five times, adding about  $\frac{1}{2}$  liter of water to facilitate the passage through the fine sieve;  $\frac{1}{2}$  liter of good buttermilk is added to the finely divided coagulum, and the entire mixture is again passed through the sieve. The bulk of the product should equal 1 liter, and, should it not, the deficiency is supplied by adding sufficient water. The mixture is now brought to the boiling-point, meanwhile *stirring thoroughly and constantly from the moment that heat is applied. This maneuver is crucial* in its effect upon the perfection of the finished product. If it is not employed, the finely divided curd will become one solid mass. This accident seems to occur with great frequency in America, while in Finkelstein's kitchen it rarely ever happens."

The product thus obtained contains: fat 2.5 per cent., protein 3 per cent., lactose 1.5 per cent.

Protein milk is thus poor in fat and sugar and rich in protein, which exists in a finely divided state as calcium paracasein.

**Uses.**—The chief value of such a milk lies in its applicability to the treatment of diarrheal conditions, notably those prevalent in the hot summer season. The low sugar content, tending to diminish intestinal fermentation, the relatively high fat content contributing to the forma-

<sup>1</sup> Marriott and Davidson, Jour. Amer. Med. Assoc., Dec. 15, 1923, vol. 81, pp. 2007-2009.

<sup>2</sup> Lowenburg, Infant Feeding and Allied Topics, 1916, 126.

tion of soap stools and the high protein in a subdivided easily digestible form all combine to make this albumin milk acceptable to infants suffering from summer diarrhea or difficulty in the digestion of protein and fat together with abnormal susceptibility to the irritant effects of sugar. The lactic acid content of protein milk is also beneficial and probably, in those cases in which the end-product is not boiled after the addition of the buttermilk, lactic acid organisms themselves have some antiputrefactive effect.

Dilution of the food may be made to fit individual cases, and when it is poorly taken saccharin may be added, 1 grain to the quart, to improve the taste.

Within four or five days after beginning this feeding, or as soon as the stools have appreciably improved, carbohydrate in the form of starch or sugar should be added to increase the nutritional value.

Ultimately the transition from protein milk to boiled milk and cereal water, or to an evaporated milk formula with low sugar content may be accomplished. Not before this time may the infant be expected to show much gain in weight.

*Typical mistakes* in protein milk feeding cited by Strauch<sup>1</sup> are as follows:

"1. Insufficient dosages of protein milk in the beginning of treatment.

"2. Too late addition or too small amounts of carbohydrate.

"3. Withdrawal of carbohydrate or excessive diminution of food during a recurrence of the symptoms of nutritional disturbance after a period of improvement."

**Dry Protein Milk.**—To meet the demand for a protein milk which could be easily made in any household without special knowledge a number of preparations of albumin milk in powder form have been marketed. These preparations require only to be added in correct amounts to warm water before feeding in order to duplicate with fair accuracy the composition of ordinary protein milk.

The analyses of several of the more common substitutes of this class are given on page 93.

In general, our experience would incline us to give preference to the original form of liquid protein milk whenever this is obtainable.

**Protein Milk Made From the Evaporated Product.**—The standard protein milk of Finkelstein and Meyer as suggested in the preceding article fails us in not a few cases, and for three reasons: (1) The patient refuses to take it because of the decidedly sour taste. (2) When taken it is not well retained in not a few instances. (3) The curd may pass through the intestinal tract unchanged. This is particularly apt to be the case in the very young.

In order to overcome the difficulties it was necessary that a method be devised that would obviate the disadvantages of the standard product, would supply something that the most delicate infant would take and retain, and that would give the results obtained with the standard product in cases in which it was impossible. At the senior author's suggestion the Walker-Gordon Laboratory made a series of experiments in preparing a protein milk, using the evaporated milk for this purpose. It seemed that

<sup>1</sup> International Clinics, vol. iv, Series 32.

if so many marantic infants could be fed on the evaporated milk by the prescription, a practice with which we have had marked success for several years, that the addition of the Bulgarian bacillus might make this milk useful in treating those of the same type who had diarrhea. It was found that the eight-hour period of incubation ordinarily employed was unnecessary for satisfactory results, likewise that the addition of protein in the form of powdered curd was not essential. It was demonstrated also that an incubation period of two hours gave a much more palatable mixture, one that was taken very readily, was rarely vomited and relieved the diarrhea, at the same time producing a gain in weight.

In the *preparation* of the milk a culture is used which is prepared as follows: One quart of skimmed milk is boiled for one hour, it is then cooled to 90° F., and divided into two equal parts. One-half tube of *Bacillus acidi lactici* is added to one portion, and one-half tube of *B. bulgaricus* to the other portion. The cultures are incubated eight hours at a temperature of 80° F., then shaken well, cooled, and kept on ice.

The protein milk is prepared as follows: One teaspoonful of each culture added to 1 pint of the evaporated milk formula employed is incubated two hours. After this time the milk should be packed in ice to prevent a further incubation.

It will be appreciated that this procedure is quite impossible in the home. It may be used, however, in any hospital in which there is an ordinarily well equipped diet kitchen.

In using this method the evaporated milk formulæ (p. 81) may be employed. It is best to use a weak mixture not giving over 1 $\frac{1}{4}$  per cent. of fat or over 3 per cent. of lactose until the diarrhea has subsided. The carbohydrate content may be increased by the use of barley flour in amount that brings the total carbohydrate percentage up to 5 or 6. As the diarrhea improves the fat and sugar content may be increased. Every summer we feed a considerable number of cases along these lines, continuing the incubation process until well on into autumn.

*Illustrative Case.*—A case demonstrating the type in which we employ this feeding was a marantic infant five weeks old weighing 6 pounds, 15 ounces. For two weeks he had been having from 5 to 7 loose green mucous stools daily. The following was prescribed: fat 1.25 per cent., protein 1.25 per cent., starch 5 per cent., lactose 4 per cent. In three days the child was reported constipated and hungry. The food was then increased to fat 1.50 per cent., protein 1.50 per cent., starch 2 per cent., lactose 7 per cent. In five days more he had entirely recovered, was hungry, and weighed 7 pounds, ten ounces, having made a gain of 11 ounces in the eight days.

Every year, particularly in the autumn, we have a large number of infants suffering from chronic indigestion in which diarrhea or a tendency to diarrhea is a prominent symptom. These infants who are usually brought to us on a barley and skimmed milk diet of varying strengths, have always been difficult feeders and have incompletely recovered from some acute intestinal disorder. With these patients the establishment of thriving has been most difficult and it is in such cases that the method presented gives brilliant results. Infants who will thrive on fresh cow's milk during the cooler months in New York City and its environment may not be able to digest the same milk during the hot months. In such

cases the evaporated protein milk has aided us greatly as a temporary substitute for a fresh cow's milk formula.

It is not claimed that the scheme presented is a method of infant feeding; it is a means of temporary feeding for sickly, delicate infants who are having a hard time. By this means we can give a well-balanced ration of increased caloric value which the patient is able to utilize, with resulting cessation of the diarrhea and gain in weight.

### THE PROPRIETARY FOODS

The foods on the market prepared for purposes of infant feeding are very numerous. From our knowledge of the composition of mother's milk we learn what nutritional elements are required, and approximately in what relative proportions these elements must exist, in order to supply the child with the food which nature intended him to have. The examination of the milk of thousands of nursing women shows that it contains from 2.5 to 4 per cent. fat, 6 to 7 per cent. sugar, and 1 to 1.5 per cent. protein; and this furnishes the balanced ration with normal caloric requirements. These figures may be put down as the normal limits of human milk, and they are so simply because the infant will thrive and grow best when the nutritional elements in approximately the above proportions are supplied to him. It is within these limits with few exceptions that the food must be kept in order that there may be normal growth and development. While the child may exist and temporarily do fairly well on a percentage of fat lower than 2.5, he will invariably show defective growth if the protein remains persistently under 1 per cent. The chief disadvantage in the infant foods which are used without the addition of cow's milk lies in the fact that they do not contain the nutritional elements as they exist in normal breast milk, and besides, of necessity, they are all cooked foods.

A further objection to the use of proprietary foods in general is their excessive cost. This is readily contributed to by advertisements which direct the feeding of babies both well and sick. It is not well to put too much reliance on the analysis sometimes published by the proprietary food manufacturer. This type of food is decidedly weak in animal fat for the reason that there is no means of keeping more than a small percentage of it in a food without its becoming rancid. When considerable percentages are indicated in the analysis it is certain that the fat does not consist of butter fat. The quantity of animal milk protein is likewise deficient, and what is present has been cooked, which detracts materially from the value of the food in infant nutrition. Scurvy is not an infrequent result of the exclusive use of these foods.

**The Uses of Proprietary Dried-milk Foods.**—It is to be remembered in spite of what has just been written that this type of food is condemned because of its being an unsuitable food when used *exclusively* and *persistently*. Hysterical general condemnation is unjust. Throughout this book the uses of the proprietary foods will be mentioned from time to time and dwelt upon. Milk is often an important factor in the production of constipation; and the importance of this food in the nutrition of "run-about" and older children who are on a general diet is secondary. In

such cases cow's milk may be replaced by one of the proprietary dried-milk, malted foods which has a laxative effect. During acute illness and in convalescence and in certain forms of malnutrition such foods are usually readily digested and may help us over difficult places.

**Proprietary Foods to Which Fresh Cow's Milk is Added.**—These are not foods in the usual acceptation of the term, and if they are used alone, independent of milk, the patient will soon present a sorry spectacle. They are largely sugars, composed of maltose and dextrose, which are derived from starch. Some contain a considerable quantity of unconverted starch. When added to the water and milk mixtures they furnish the soluble carbohydrates and free starch, and thus fulfil this function of the food with results as good as, but usually no better than, those obtained with milk-sugar and a cereal gruel. Maltose is a laxative sugar. In some cases of constipation in the bottle fed it may replace the milk-sugar in equal quantity, with decided advantage. In other cases this change to maltose is without effect.

According to our observation, the statement that the addition of maltose to cow's milk facilitates its digestion is unfounded. We have tried this method in many cases, but have never been able in consequence to use a stronger cow's milk mixture. The true test of such a measure is in treating the delicate and in feeding difficult cases, rather than well babies who thrive regardless of the carbohydrate employed. The maltose preparations, then, in the sense that they may contain a small amount of protein and a laxative sugar, are useful and to be recommended when such a carbohydrate is needed.

**The Proprietary Beef Foods.**—Numerous preparations of this nature are on the market, and there has been abundant opportunity to test their value. Without going into a lengthy discussion as to how and under what conditions these preparations have been used, it is sufficient to say that as means of nutrition for children they play a very unimportant part. Their principal use is in illness, in which they act as a stimulant, and to a less degree as a food. They all make weak protein mixtures when diluted so that the child can take them. The possibility of supplying any great amount of nutrition by their use is negligible; occasionally, however, they may be used to advantage. When milk is withdrawn, they may be added to the cereal gruel substitute. If there is diarrhea, great care must be exercised, as the proprietary beef preparations as well as beef juice may aggravate this condition. On account of the creatinin which they contain these foods should not be given in any of the forms of nephritis. Another obstacle which limits their use is that a child soon tires of them. They can rarely be given more than two or three times in twenty-four hours. Valentine's is the preparation usually selected. It may be given in solution— $\frac{1}{4}$  to  $\frac{1}{2}$  teaspoonful to 6 ounces of the diluent.

**The Composition of Infant Foods.**—In the table on p. 93 an attempt is made to group some of the more common proprietary foods according to their leading characteristics and to give fairly dependable figures showing the respective analyses. The list of such foods is being constantly augmented and there is no guarantee that change in the manufacture of any one of the patent foods may not at any time alter the proportions of its ingredients. For practical purposes in spite of the fact that the

Group.	Name of food.	Percentages.						
		Fat.	Carbohydrate.				Protein.	
			Cane-sugar.	Lactose.	Maltose.	Dextrins.		Starch.
<i>Condensed and Evaporated Milks</i>	Condensed Milk, Borden's Eagle Brand.....	9.6	43	12	....	....	....	8
	Evaporated Milk, Borden's unsweetened.....	8.3	...	10	....	....	....	7
	Evaporated Milk, Dairy Va.....	8.1	...	10	....	....	....	7.3
<i>Dry Milks—Plain</i>	Dryco.....	12	...	46	....	....	....	32
	Mammala.....	12.1	...	55.3	....	....	....	24.3
	Klim.....	28	...	38	....	....	....	26.7
<i>Malted Dry Milks</i>	Malted Milk, Borden's.....	8.5	...	13.7	38.8	17	....	8.7
	Malted Milk, Horlick's.....	8.8	...	49.1	25	18.8	....	16.3
	Latbose.....	17	...	25	....	5	....	18
<i>Starchy Foods</i>	Allenbury's Food No. 1.....	18.6	...	42	14	10	....	10.6
	Allenbury's Food, No. 2.....	15.8	...	36	20	13	....	9.9
	Allenbury's Food, No. 3.....	1.05	...	...	16.5	8.5	60..	10.2
<i>Starchy and Sugar Combinations</i>	Nestle's Food.....	5.5	25	6.6	27.4	15.4	15.4	14.3
	Imperial Granum.....	1.0	Dextrose 0.4		1.38	73.5	14	
	Ridge's Food.....	0.3	Lactose, largely, 7.8		....	74	12.5	
<i>Malt Sugar Foods</i>	Benger's Food.....	0.9	3.3		....	77	12.1	
	Eskay's Food.....	3.5	...	54	....	1.7	6.7	
	Allenbury's Food, No. 3 <sup>1</sup> .....	...	...	...	...	30	...	
<i>Dry Protein Milks</i>	Nestle's Food <sup>1</sup> .....	...	...	...	...	...	...	
	Dextrimaltose, No. 1—Mead's.....	0.16	...	...	52	41	10.35	
	Mellin's Food.....	...	...	58.9	20.7	...	...	
<i>Dry Protein Milks</i>	Protein Milk, Merrell-Soule Co.....	27	...	24 (Free lactic acid 3)	....	....	38	
	Albumin Milk, Hoos.....	30.15	...	21.5 (Lactic acid 3)	....	....	38.3	
	Laroson, "Roche" (A casein-calcium powder to be added to milk and boiled).....	0.3	...	...	....	....	85 (CaO 2.5 P <sub>2</sub> O <sub>5</sub> 2.2)	

<sup>1</sup> Analyses under Malted Dry Milks.

figures given are derived from various sources,<sup>1</sup> including in some instances the manufacturer's labels, the data is sufficiently accurate.

### SPECIAL SUPPLEMENTARY FOODS AND THEIR PREPARATION

Numerous adjuvants to milk are of value in infant feeding, particularly as a means of fulfilling the demands of the borderline period between infancy and childhood. For short intervals certain of these foods may be used as substitutes for milk when the latter for any reason is unavailable or is poorly tolerated.

#### FORMULÆ

*Beef Juice.*—Take a round steak, cut into pieces the size of a horse chestnut, place in a buttered pan in a hot oven, and bake for fifteen minutes; remove from the pan and press out the blood; add salt to the taste.

*Beef, Mutton, and Chicken Broth.*—Take 1 pound of meat free from fat, cook for three hours in 1 quart of water, adding water from time to time, so that when the cooking is completed there will be 1 quart of broth. When the broth is cool, remove the fat, strain, and add salt to the taste.

*Scraped Beef.*—Broil round steak slightly over a brisk fire. Split the steak and scrape out the pulp, using a dull knife.

*Egg-water.*—The white of 1 egg, thoroughly beaten in 1 pint of cold boiled water; strain; add salt to the taste.

*Coddled Egg.*—Take a fresh egg, place it in a pan of boiling water, put on the back of the stove and stand for three minutes, having pan tightly covered.

*Cornstarch Pudding.*—Dissolve 1 tablespoonful of cornstarch in a little milk. Heat 1 pint of milk to nearly boiling-point. Add cornstarch slowly, then 1 tablespoonful of sugar and stir until it thickens. When cool add 5 drops of flavoring.

*Soft Custard.*—Heat 1 cup of milk to boiling-point. Add 1 yolk of egg well beaten, one teaspoonful of sugar, and a pinch of salt. Cook in a double boiler, stirring until it thickens. Strain and add 5 drops of flavoring.

*Oatmeal Jelly.*—Oatmeal, 4 ounces; water, 1 pint; boil for three hours in a double boiler, water being added, so that when the cooking is completed a thin paste will be formed. This while hot is forced through a colander to remove the coarser particles. When cold a semisolid mass will be formed.

*Wheat Jelly and Barley Jelly.*—Wheat jelly and barley jelly are made in the same way as oatmeal jelly, using cracked wheat or barley grains.

*Barley-water No. 1.*—Robinson's barley flour or Cereo Co.'s barley flour, 1 rounded tablespoonful; water, 1 pint. Boil thirty minutes; strain; add water to make 1 pint.

In making *barley-water No. 2*, 2 tablespoonfuls of the flour are used, and for *No. 3*, 3 tablespoonfuls are used.

*Rice-water No. 1.*—Rice, 1 tablespoonful; water, 1 pint; boil three

<sup>1</sup> Morse and Talbot, *Diseases of Nutrition and Infant Feeding*, 1915, 230, 231; Holt and Howland, *Diseases of Infancy and Childhood*; Mellins Food Co., *Proprietary Foods, Formulæ*.

hours, adding water from time to time, so that there is 1 pint of rice-water at the end of the three hours.

In making *rice-water No. 2*, 2 tablespoonfuls of rice are used.

*Oatmeal-water No. 1.*—Oatmeal, 1 tablespoonful; water, 1 pint; cook three hours and add water to make 1 pint.

In making *oatmeal-water No. 2*, 2 tablespoonfuls of oatmeal are used.

*Percentage Gruel Flours.*—There is on the market in tin boxes, the covers of which are used as measures, a series of flours, especially made for preparing cereal gruels and jellies of known percentage composition. On the labels are given only the cooking directions for preparing plain or dextrinized gruels, and their composition when different quantities of flour are used. They are as follows:

APPROXIMATE COMPOSITION OF GRUELS MADE FROM CEREAL CO.'S GRUEL FLOURS

	Barley.		Legume. <sup>1</sup>		Oat.		Wheat.	
	Proteins.	Carbo-hydrates.	Proteins.	Carbo-hydrates.	Proteins.	Carbo-hydrates.	Proteins.	Carbo-hydrates.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
$\frac{1}{4}$ ounce flour to quart of water.....	0.12	0.60	0.19	0.53	0.12	0.60	0.10	0.62
$\frac{1}{2}$ ounce flour to quart of water.....	0.24	1.20	0.39	1.06	0.24	1.20	0.20	1.25
$\frac{3}{4}$ ounce flour to quart of water.....	0.36	1.80	0.58	1.59	0.36	1.80	0.30	1.88
1 ounce flour to quart of water.....	0.48	2.40	0.78	2.12	0.48	2.40	0.40	2.50
2 ounces flour to quart of water.....	0.96	4.80	1.56	4.24	0.96	4.80	0.80	5.00
3 ounces flour to quart of water.....	1.44	7.20	2.34	6.36	1.44	7.20	1.20	7.50
4 ounces flour to quart of water.....	1.99	9.60	3.12	8.40	1.92	9.60	1.60	10.00

<sup>1</sup> Made from equal parts of peas, beans, and lentils.

*Dextrinized Barley-water.*—Robinson's barley flour or Cereol barley flour, 3 tablespoonfuls; water, 1 pint; boil thirty minutes; add water to make a pint. When lukewarm (100° F.), add 1 teaspoonful of Cereol; strain; this changes the starch into dextrinized maltose.

*Oatmeal-water No. 1.*—Oatmeal, 1 tablespoonful; water, 1 pint; cook three hours and add water to make 1 pint.

In making *oatmeal-water No. 2*, 2 tablespoonfuls of oatmeal are used.

*Imperial Granum-water No. 1.*—Imperial Granum, 1 tablespoonful; water, 1 pint; cook thirty minutes and add hot water to make 1 pint.

In making *Granum-water No. 2*, 2 tablespoonfuls of Granum are used.

*Whey.*—Put 1 pint of fresh milk into a saucepan and heat it lukewarm, not over 100° F.; then add 2 teaspoonfuls of Fairchild's essence of pepsin and stir just enough to mix. Let it stand until firmly jellied, then beat with a fork until it is finely divided; strain, and the whey, the liquid part, is ready for use.

*Junket.*—To 1 pint of fresh milk add 2 teaspoonfuls of sugar and 1 junket tablet or 2 teaspoonfuls of essence of pepsin. Allow it to stand over a fire until the temperature is 100° F.; then add vanilla as a flavoring and allow it to stand until the curd is set, when it should be placed on ice.

*Prune Juice.*—Take 1 pound of prunes, wash thoroughly, place in a pan, cover with cold water, and allow to stand over night. Place on stove next morning, bring to a boil, and allow to simmer until very soft. Strain

off the juice (which should be 8 ounces) and give the required amount for the infant.

For older children the pulp may be used with the juice after putting through a sieve.

*Lactic Acid Milk.*—The preparation of lactic acid milk is described on page 87.

### MILK FOR TRAVELING

In making long journeys with infants by land or water the feeding of the child is an important matter, and advice is often sought by mothers who wish to make the contemplated trip with the least possible risk. It is, of course, desirable that no change be made in the milk commonly used, and there are means of treating the milk and of keeping it which enable us to assure the patient of reasonable safety. It is convenient with New York City children to have the milk prepared at the Walker-Gordon Laboratory, where at a trifling expense small ice-boxes can be obtained which contain sufficient space for a few days' supply of milk and which can be conveniently carried on cars and boats. Larger boxes with a capacity of 12 quarts may be used for an ocean voyage. The smaller box will need refilling with ice, which is usually readily secured once or twice a day. The larger box for ocean voyages is packed in ice and placed in a cold-storage room of the vessel and will not need repacking during the trip. The milk prepared for a journey should be cooled to 45° F. as soon as it is drawn and kept at this temperature until it can be sterilized at a temperature of 212° F. for twenty minutes. It should then be cooled rapidly to at least 50° F. and kept at this point until used. These directions can be carried out by any intelligent family. When this is done, the milk will be safe for use for the time required—from seven to eight days. Of course, laboratory milk is available for comparatively few. But the suggestion as to the making of an ice-box can be followed in any town or village, so that a milk laboratory is not essential. All that is required is the ice-box, the quart fruit-jars or quart milk-bottles, and clean milk. Those who for any reason cannot avail themselves of the milk thus preserved will find in canned evaporated or condensed milk or in dry milk a fairly good substitute.

Malted milk or any of the dried milks on the market may be used as a temporary substitute for cow's milk.

### SUBSTITUTES FOR STOMACH FEEDING

In the management of the diseases of children conditions arise from time to time which necessitate the nourishment of the patient by channels other than the stomach. In persistent vomiting, when there is an acute congestion of the stomach, as in an acute gastro-enteric infection, in cyclic vomiting, and in vomiting due to some more remote cause, as meningitis or nephritis, the patient must receive water and food in order to sustain the system until the exciting factor is removed.

Nutrition by means other than stomach feeding may be necessary in retropharyngeal adenitis or abscess, in stricture of the esophagus, in diphtheria, in the exanthemata, and in pneumonia during the course of active delirium. A substitute for stomach feeding is also often useful

in marasmus, for the generally delicate, and in nourishing those with reduced assimilative powers. Various means of substitute feeding have been attempted from time to time. Nutritive suppositories have been advocated and proved failures, perhaps because of our inability to place them sufficiently high in the bowel. Placed in the rectum, they excite peristalsis and are expelled.

**Rectal and Colonic Feeding.**—Any means of treatment which is disagreeable both to patients and attendants, and difficult of execution, is very liable to fall into disfavor unless pronounced beneficial results are the rule. While absolutely nothing can be promised so far as supplying nutrition by this means is concerned, careful observation and experience tell us that in a certain number of cases the measure is of much value. When the treatment will be of service in nourishing the patient can be determined by trial only. In children, particularly in very young children, on account of the ease with which peristalsis is excited, nutrition by this means is less frequently successful than in the adult. Nevertheless, the method has been of material assistance in many a trying situation.

Not a few of the failures are due to a lack of appreciation of the details of the procedure. Directions to mothers or nurses to inject a certain quantity of some particular food, unless specific instructions are given, will usually be carried out as follows: A hard glass or rubber tip will be passed into the rectum from 1 to 2 inches. Through this the fluid will be forced. In a very few minutes, perhaps immediately, the bowel will empty itself into the napkin or bed-pan, the enema being of no service. This is what may be expected and what will happen when the child is given the nutrient enema in this way. The hard tip, placed within the anal ring, and the fluid are very apt to excite vigorous peristalsis.

In order that the nourishment may be retained, it should be carried high up into the descending colon. The advantages of this method are that the fluid is much better retained, and, on account of the greater surface of mucous membrane with which it comes in contact, it will be quickly and more completely absorbed.

*How to Give a Nutrient Enema.*—The nutrient enema is best given as follows:

A soft-rubber catheter, No. 18 American, or a small adult size rectal tube is slipped over the small tip of an ordinary fountain-syringe. The tube should not be too flexible nor yet too stiff, and the catheter is to be preferred. If too flexible, the instrument folds readily on itself when the point meets with any resistance, and the fluid escapes perhaps 1 or 2 inches within the anal opening. If the tube is too rigid or if force is employed, the mucous membrane and the parts may very easily be lacerated.

The position of the child while the enema is being given is important. He should rest on his left side, preferably in Sims' position, with the buttocks elevated to a plane at least 4 inches higher than the shoulders. A pillow or a folded blanket covered with a rubber sheet should always be available for this purpose if a bed-pan is not at hand. The child, if old enough to understand, should be assured that no harm will come to him. With the patient in position and an assistant to hold him, the anus is

covered with vaselin. It is not enough to oil the tube. The tube attached to a fountain-syringe is warmed and well oiled and passed into the rectum. The lower end of the bag should be 3 feet higher than the child's body. There may be some straining at first, but with the child in a proper position one may pass a tube of the right degree of flexibility high into the intestine in a few seconds. The tube should be introduced about 9 inches—far enough at least to be felt in the descending colon; then the fluid is allowed to pass rapidly into the bowel. When the bag is emptied, the tube is rapidly withdrawn and the child, although allowed to change to the dorsal position, is encouraged to rest on his side. In any event the buttocks must be kept elevated for at least one-half hour. In using small amounts of fluid it is well to allow for the quantity which may remain in the tube of the syringe and in the catheter after the enema is given. In managing older children, who exert much bearing down or straining, it may be necessary to attach the catheter to a Davidson syringe or to an ordinary rubber or glass piston-syringe of large size, in order to provide sufficient force to overcome the pressure exerted by the abdominal muscles.

The nutriment should be neither too hot nor too cold. With either of these extremes, peristalsis is apt to be excited. A temperature of 95° F. is the most satisfactory. If bowel action has been fairly free, previous washing with a normal salt solution is not necessary. If there has been no movement for six hours, it will be well first to use an irrigation of normal salt solution. Glycerin should not be used. The irrigation should precede the enema by from fifteen minutes to half an hour.

*Nourishment Not to Be Used in the Rectum.*—Oils or fats in any form, even though pancreatinized, should not be used. Alcohol should be used only in very urgent cases, and then it should be well diluted and used not oftener than once or twice in twenty-four hours, because it has a decidedly irritant action on the intestinal mucous membrane and is not well retained. When used alcohol should be diluted with from 12 to 16 parts of water or an equal quantity of skimmed milk, which has been peptonized or pancreatinized. In giving stimulants by the rectum, whisky is usually employed in quantities from  $\frac{1}{4}$  ounce for a child two years of age, to 1 ounce for a child from six to ten years of age.

*Nourishment to be Used.*—By far the best food for rectal alimentation is skimmed milk completely pancreatinized. It is better retained and more completely assimilated than any other form of nutriment which we possess. In cases in which it is desired that a considerable amount of fluid be absorbed by the intestine, the pancreatinized milk may be diluted with normal salt solution. Where such milk is not available, the whites of 3 raw eggs, mixed with a normal salt solution, may be given. Not infrequently the whites of 1 or 2 raw eggs are given in the pancreatinized skimmed milk, this combination constituting the best form of nutrient enema. The predigested proprietary preparations, the so-called "peptones," have not proved satisfactory in our hands.

The amount of nourishment to be used at one time varies with the age and condition of the child.

## ORDINARY AMOUNT TO BE GIVEN IN ENEMA

Under three months.....	2- 4 ounces
From three to six months.....	4- 6 "
From six to twenty-four months.....	6- 8 "
After the twenty-fourth month.....	8-16 "

Because the first enema is not retained, it does not follow that a second given immediately thereafter will share the same fate. In not a few instances, when the second enema has been given ten minutes after all or the greater part of the first had been expelled, the entire second amount has been retained. It is rarely wise to repeat the enema oftener than at six-hour intervals, and when the intestine shows a tendency to intolerance the intervals should be increased to eight or ten hours.

This means of nutrition in children is of temporary use at best. The period of its application in the average case, even when tolerated at first, is only two or three days. In a few instances it has been found practicable to use the method longer.

*Illustrative Cases.*—During the summer season a very delicate three-month-old child, weighing 6 pounds and 10 ounces, retained 2 ounces of completely pancreatinized skimmed milk, given at six-hour intervals for three days, and 3 ounces at eight-hour intervals for eight days longer, making a period of eleven days in which the enemata were employed. Such tolerance of the large intestine, however, is very rare.

In another case the use of enemata following an operation for intestinal obstruction with protracted vomiting and prostration unquestionably saved a child's life.

In a third severe case of cyclic vomiting, which was seen in consultation, the vomiting had persisted for three days. This child was six years of age. He showed marked emaciation, and suffered from intense thirst; his pulse was weak and soft. A nutrient enema was given, composed of 8 ounces of pancreatinized skimmed milk, 8 ounces of normal salt solution, and the whites of two eggs. Not one drop was expelled. In one-half hour the boy claimed to feel better. The intense thirst was relieved and he fell into a restful sleep. In six hours the enema was repeated, about 4 ounces being expelled. This was followed by enemata at eight-hour intervals, 8 ounces of the milk with the whites of two eggs being given, all of which was retained. At this point the vomiting abruptly ceased and further enemata were not required.

## COMMON DIGESTIVE DISORDERS OF INFANCY

**The Recognition of Digestive Disturbance.**—In order successfully to carry on the feeding of an infant one must be alert to slight departures from the normal which singly are often overlooked and many times are of no significance, but collectively make up the picture of "disturbed balance" which may be followed by persistent indigestion.

Successful infant nurses and the mothers of large families acquire a sort of sixth sense, the possession of which enables one to judge whether an infant is doing well or poorly even before a change in the appearance or behavior of the baby can be detected by the less experienced.

The value of such a developed instinct is unquestionable. It may be acquired by any one who will make the study of minor manifestations on the part of the infant a serious undertaking.

**Hunger.**—In the case of a strong, lusty nursing an error in diagnosing hunger can hardly be made. The insistent cry, the crowding of the baby's hands into his mouth, the beginning of sucking even before the nipple can be grasped, the recurrence of the cry when nursing is interrupted, the normal sleep following the filling of the stomach all make unmistakable the recognition of the infant's simple periodic need for food. In the bottle-fed infant who has a poor digestive capacity or has been

improperly fed the hunger symptoms may pass unrecognized. Hunger in such an infant is often associated with colic or may follow directly after vomiting, or recur without apparent reason after a feeding in caloric value far above the normal requirements. To understand such a case, to correctly gage the relative importance of hunger and more serious disturbance, in guiding the feeding, and to withhold increase in food in the presence of a consistent gain by a baby who "is always hungry," calls for a differentiation between normal and abnormal hunger, possible only when all the factors are considered by one who is experienced.

In general, hunger in the absence of vomiting or symptoms indicative of intestinal indigestion may be taken as a favorable symptom and not infrequently will justify a temporary increase in food, disproportionate to computed caloric needs. In the event of rapid gain following such increase in the food, the hunger manifestations will probably diminish in intensity so that the food may be maintained without further increase till the augmented weight of the infant entitles him to more.

**Hiccup** due to spasm of the diaphragm is ordinarily a minor symptom due to the distention of the stomach with air swallowed at a too rapid nursing, or to the presence of gas from carbohydrate or butyric acid fermentation. This symptom may be relieved by the administration of a little very warm water and by holding the infant upright and patting his back. Persistent hiccup may yield to warm abdominal applications and an enema.

The baby with recurrent hiccup should have slower feedings, food in smaller volume, and possibly food with lower carbohydrate and fat content. If he does not vomit or show by his stools evidence of indigestion, the hiccup may be interpreted simply as a mild warning that digestive capacity is being moderately taxed.

**Colic.**—This is a more serious condition due to the presence of gas in the intestine. The peristalsis thus excited takes the form of definite cramps upon the occurrence of which the subject draws up the legs and screams. The diagnosis of colic is facilitated by noting the presence of tympanites and the occasional passage of gas from the bowel at which times the baby may manifest relief. A saline enema affords more lasting relief. A discussion of this condition in greater detail will be found in the section on Intestinal Diseases, pp. 225-227.

**Vomiting.**—The significance of this symptom depends upon its character and cause.

Vomiting with eructation of gas is often due to neglect of the practice of patting the infant on the back while he is held upright after feeding. Air swallowing from too rapid feeding increases this susceptibility.

Simple regurgitation or "spilling over" is regarded as a physiologic form of relief to an overfilled stomach. The indication to meet this condition is obvious. In infants of a neuropathic type (of which class there are not a few) this habit may become complicated by actual rumination.

Sour vomiting at intervals indicates fermentation from too much fat or sugar in the feeding. High fat feeding tends to induce retention of gastric contents beyond the period when emptying is normally accomplished. Vomiting of very acid contents in such cases frequently follows the taking of a fresh feeding.

Other common forms of vomiting (p. 199) with the important exceptions of those types dependent on spasm and obstruction in the gastrointestinal tract belong less exclusively to infancy.

Pylorospasm and pyloric stenosis occasion forcible projectile vomiting of a type requiring special consideration. (See p. 207.)

Intussusception and congenital obstruction of the intestine present surgical signs and symptoms.

Vomiting dependent on reflex causes (particularly teething), vomiting with pertussis, meningitis, peritonitis, and the onset of acute infective diseases with fever, and finally, the vomiting belonging to acidosis, all occur in infancy and require treatment considered under discussion of the respective underlying conditions, to be presented later. To many cases the treatment outlined in the section on Acute Gastric Indigestion (p. 200) is applicable.

Certain particular phases of the subject of vomiting in infancy may be considered at once. The vomiting infant should be watched by the physician for a considerable time to determine the nature of the vomiting, because statements by the family cannot always be relied upon. The vomiting may be projectile. This, if habitual, is very apt to mean the existence of pylorospasm or hypertrophic pyloric stenosis (p. 207). In vomiting due to unsuitable food productive of gastric irritation the ejected material usually comes up in large mouthfuls during the interval between feedings, and is of a disagreeable sour odor. Regurgitation of small amounts of partially digested food may occur in this type of case. In all such cases, however, rumination (p. 206) is to be thought of, a condition which, although fairly common, is usually overlooked by the attending physician. It is very sure to be overlooked if the child is not watched for a half-hour or so after the feeding. Spasmophilic infants vomit much more readily than those not so constituted, but we have never been impressed by the so-called "nervous vomiter" or "habit vomiter."

Careful observation of such cases will usually disclose a hyperstalsis or pylorospasm. The point of hyperstalsis is frequently overlooked. The pyloric opening at best is small, and the overacting stomach in its efforts to force food through the pylorus is very apt to take on a reverse stalsis, with resulting rejection of the food.

Every year we see several cases in which the vomiting is apparently due indirectly to mucous gastritis. In these infants there is a production of thick gelatinous mucus which covers the lining of the stomach and unquestionably plugs the pyloric orifice and acts in a mechanical fashion to prevent the passage of the food, the results being identical with those of pylorospasm.

In the cases that are occasioned by unsuitable food and resulting gastric irritability the treatment is obvious and will be found under Acute Gastric Indigestion (p. 200). For all vomiting infants, regardless of the nature or cause of the vomiting, the use of a daily stomach washing is always of advantage, and in some instances gives most surprisingly favorable results. The cases of mucous gastritis particularly are quickly relieved by daily stomach washing. Because of this tendency to varying degrees of mucous gastritis in all deranged stomachs, whether the causative factor is mechanical or otherwise, lavage is indicated. A

5 per cent. solution of bicarbonate of soda is the fluid used. From 2 to 4 ounces should pass into the stomach and be siphoned out, this procedure being repeated until the water is clear.

**Constipation.**—This is perhaps the most common functional digestive disorder of infancy. Its consideration in detail is taken up on p. 267. When present in a feeding case that presents no other departures from the normal, constipation rarely constitutes a serious problem. It is noteworthy that constipated babies (perhaps because the slow expulsion of the intestinal contents gives more time for complete food absorption) characteristically gain weight rapidly.

Obstipation, in distinction from constipation, serves as a valuable symptom in the differentiation of pyloric stenosis from simple pylorospasm.

**Diarrhea.**—Frequent watery stools are common in breast-fed infants during the first days of life and have little significance. As the breast milk improves the diarrheal tendency usually subsides. In other instances the frequent stools may persist and the condition may perhaps be traced to errors in the mother's diet or laxatives which she is taking and excreting in part through the medium of her breast milk. Diarrhea in the bottle fed, as a rule, demands lowering of the sugar content in the infant's food, and frequently the adoption of gruel to replace the sugar removed. Intestinal indigestion and the various inflammations of the intestinal tract in which diarrhea is the prominent symptom are discussed in a later section (pp. 230–253).

**The Ammoniacal Diaper.**—Probably every physician has been told by the mother or nurse that the baby's diaper smells of ammonia. Southworth found in a study of several cases that the condition was readily corrected by eliminating or reducing the fat in the milk or by giving alkalies, such as magnesia or citrate of potash.

This author, quoting Czerny and Keller, accounted for the excessive ammonia excretion as "depending upon the chemical property of ammonia to combine with acids as an alkaline base. While under normal conditions all but a little of the ammonia becomes urea and is excreted as such, if under abnormal conditions there is present in the body an excess of unoxidized acids for whose neutralization the available supply of fixed alkalies does not suffice, the ammonia can then take the place of fixed alkalies and form with the acids ammonia salts, which will be excreted in the urine." Zahorsky<sup>1</sup> found that the disorder was largely limited to artificially fed infants and that high fat milk feeding and the giving of orange juice and of egg were among the etiologic factors in causing the ammoniacal diaper. The ammonia was found to be liberated from ammonia containing compounds in the urine under the action of an alkali present in the diaper—soap, lye, lime, or stool.

Cooke<sup>2</sup> demonstrated the presence of a urea-fermenting, ammonia-producing organism, "*Bacillus ammoniagenes*," in the stools of artificially fed infants with ammoniacal diapers. The ammonia production was found to be inhibited by acid intestinal contents, being reduced when the intake of fat was low, and in the case of the breast-fed infant. When the

<sup>1</sup> Amer. Jour. Dis. Child., vol. x, 1915, pp. 436–444.

<sup>2</sup> Ibid., November, 1921, pp. 481–492.

diaper was impregnated with antiseptic the ammonia formation was readily controlled.

*Treatment.*—The management of these cases as suggested above consists in reducing the fat to the child's capacity, or in the use of alkalies. In most cases the reduction of the fat content in the food has been all that was required.

Persistent ammonical urine not infrequently follows prolonged feeding of dry milk owing to defective utilization of the high protein content in this food. If the ordinary measures are not effective in relieving the condition in such a case, the substitution of another form of food is indicated.

The practice recommended by Cooke of wringing out the dry, clean diapers in boric acid solution, 1 : 20, and again drying them before applying is a dependable routine preventive measure applicable to all cases.

**Evidence Afforded by the Stools.**—*Breast Milk Stools.*—Infants on the breast average two to three large stools daily, although the number may range from one to five and still be consistent with perfect health. Their color is usually of a bright yellow or orange tint, and their character of a smooth and homogeneous consistency, with a slightly acid reaction. The odor is not as offensive as that of the cow's milk stool, as there is less putrefaction of the breast milk protein while in the intestinal tract. The bulk or residue corresponds to the amount of ingested food.

*Cow's Milk Stools.*—Infants on the bottle usually average only one stool a day, which often is smaller than that of the breast-fed baby. The color is lighter and the proportion of feces to the amount of food taken numerically less when the infant is artificially fed.

*Hard Constipated Stools.*—A hard constipated stool, when not produced by any mechanical cause, is usually due to a deficiency in the food of either carbohydrates or fats, generally the latter. Food too low in total solids, leaving an insufficient residue, is also a cause. Irregular habits in the time of going to stool and a lack of systematic general training also play a part. Sterilization and, to a lesser degree, pasteurization, make milk somewhat constipating.

*Loose Watery Stools.*—This type of stool is seen in indigestion, with fermentative changes in the carbohydrates, and to a lesser extent in the fats. The stools vary in color from a yellow or yellowish brown to green. They are usually alkaline in reaction and have a foul, musty odor. Curds are seldom seen and there is very little mucus.

*Stools in Hard Balls.*—This variety of stool is usually due to an excess of fat in the food. The feces vary in color from a light yellow to a light gray. They are sometimes large and hard, and at other times dry, small, and crumbly.

*"Scrambled Egg" Stools.*—Stools of this order are seen when the carbohydrate digestion is at fault. Bacterial fermentation of the starch or sugar which is not assimilated by the organism gives rise to loose, green, frothy movements. These are very acid, frequently causing excoriations of the buttocks and surrounding parts.

*Mucus in Stools.*—Mucus excretion denotes a form of irritation in the digestive tract which gives rise to an excessive secretion from the mucous glands of the intestine. It is almost invariably present in ab-

normal stools. Mucus intimately mixed with feces indicates the source of the trouble to be in the small intestine; if on the outside of a constipated stool, in the rectum; or if in combination with a clay-colored stool, in the duodenum.

*Blood in Stools.*—In older children blood intimately mixed with the stools would suggest an ulceration of the stomach or small intestine. When on the outside of a constipated stool the blood may indicate a rectal lesion, an anal fissure, diverticuli, or incomplete intussusception. A stool composed of a jelly-like mass of blood and mucus without fecal material is very characteristic of intussusception. *Malena neonatorum* or hemorrhage of the newborn is characterized by a profuse discharge of blood from the rectum.

*Curds in Stools.*—Curds are one of the most frequent of the abnormal constituents. Two kinds are found: one firm and tough and very hard to press out, insoluble in ether, varying in size from a small pea to a hickory nut, with a brown or greenish coating, but white on cross-section, known as a protein curd; the other is composed of fat, easily pressed out, does not sink in water, varies in color from white or yellow to green, is somewhat soluble in ether, and is not hardened by formalin.

*Stool Examination.*—Much may be learned from the gross appearance of the feces. Variations in color ranging from the clay color characteristic of the presence of fat and absence of bile, to the dark green or black stool produced by the ingestion of spinach, bismuth, or iron are all readily appreciable by the naked eye. The consistency of the stool, its size, and many other points regarding it are also readily apparent, and much additional information relating to the presence of such contents as strings of mucus and foreign substances may be obtained by pressing a portion of the stool between glass plates.

For the determination of the finer degrees of digestive capacity, and the bacterial content of the feces, microscopic and chemical analysis is essential.

A few of the more common tests are the following:

Fat droplets not ordinarily present in the stool to any marked extent are stained black by osmic acid, and orange with 3 per cent. sudan III in 50 per cent. alcohol.

Fatty acid crystals, the presence of which is abnormal, are detected on cooling a slide upon which has been heated a drop of feces and 2 drops of 30 to 50 per cent. acetic acid.

Starch grains are stained dark blue or black by Gram's iodine solution.

The proportion of Gram-positive to Gram-negative bacteria in the stool is less important than the type of organism predominant. In the stool of protein putrefaction *Bacillus aerogenes capsulatus* and *B. putrificus* or their spores are significant. In that of carbohydrate fermentation *B. acidophilus* and Gram-positive diplococci predominate over the organisms of the colon group and *B. aerogenes capsulatus*. Pathogenic organisms of common occurrence are those of dysentery, including *Amoeba coli*, *B. typhosus*, the tubercle bacillus, and streptococci productive of membranous colitis.

The presence of occult blood is best determined by the benzidine test.

Carbohydrate fermentation and protein putrefaction may be studied

by simple fermentation tests combined with color and reaction observations.

For the actual details of microchemical examination of the feces the reader should consult a standard work on clinical pathology.

## DISORDERS OF NUTRITION IN INFANCY

### MARASMUS (ATHREPSIA; INFANTILE ATROPHY)

Under the title of marasmus will be considered those cases which are associated with and dependent upon derangement of function of the gastro-enteric tract. Tuberculosis, syphilis, and atelectasis are consequently excluded, these affections being considered elsewhere under their respective headings.

**Age.**—Marasmus is seen most frequently in young infants under nine months of age. Cases are frequently seen, however, from the ninth to the twelfth month, and comparatively few between the twelfth and eighteenth months.

**Etiology.**—A great deal of research work has been done among marasmic infants in order to determine the nature of the condition, but as yet no satisfactory explanation has been offered. The disease is unquestionably due to defective intestinal assimilation. The principal fact that disproves the existence of any atrophic condition or necessarily severe derangement of function is that these patients very often make complete recoveries, becoming perfectly normal children after three months or more of treatment.

**The Usual History.**—The history of these cases is as follows: The mother could not or did not nurse the baby. The child was put on cow's milk, which was usually given too strong or in too large quantities—often both errors were combined, or the milk may have been too old when used, and improperly cared for; in any case the milk disagreed, the child was made ill, there was loss in weight, cow's milk was discontinued, and one of the infant foods, alone or combined with milk, was given. The child's digestion was thoroughly disordered, and the foods failed to agree. There was vomiting or regurgitation, with undigested, green stools, or both combined, while the loss in weight continued. The child may have been inherently weak or may have shown a cow's milk idiosyncrasy to help account for the lack of success in the milk feeding. Usually there followed a series of experiments with different kinds of food and methods of feeding, the vomiting, diarrhea, or colic continued with wasting, and when the child reached the hospital or office he was perhaps six months of age and weighed from 6 to 9 pounds, presenting a typical athreptic picture. Some of these children are born with a digestion that is apparently incompatible with cow's milk mixtures. Others have their digestive capacity for cow's milk hopelessly deranged by improper feeding methods. The majority of the cases occur among the overcrowded tenement poor—the worst possible environment for a delicate infant. There is little or no protein assimilation, so that any approximation to normal growth is impossible. Marasmic infants may also possess a poor fat capacity, and if there is, in addition, a diminished sugar capacity the proteins of the tissues are drawn upon to supply heat and energy, with re-

sulting progressive emaciation. Heredity, environment, and the season of the year all influence the prognosis.

*Infection as a Contributing Factor in Marasmus.*—In our management of athreptics we have been so occupied with nutrition and the gastro-intestinal fault that other possible etiologic agencies may have been neglected. Occult infections may and do play a very decided part in some of these cases. Thus during a service at the Babies' Hospital, out of 17 cases in which blood-cultures were made, 5 were positive, and of these 5 infants, 4 died. Of the remaining 12 patients with negative cultures, 8 died, and of the 4 that recovered, 1 had an otitis; and 1 a furunculosis of mild degree, while the remaining 2 had no demonstrable lesions. Of the 8 fatal cases, there were only 2 in which there was no evident infection. The infection varied from an otitis to a severe bronchopneumonia.

The blood-cultures in each case were taken when the infant was losing in weight and apparently retrogressing without any digestive disturbances. In two instances the clinical evidence (if it might be called such) consisted simply of a subnormal temperature, well-digested stools, and progressive loss in weight. In two others there existed a temperature and later signs of a bronchopneumonia, while a third showed Klebs-Löffler bacilli in the nose. Blood-counts were of no aid in diagnosis.

Marasmic infants who fail to thrive on suitable food and good general management, whether there are evident digestive disturbances or not, should be thoroughly examined for hidden infections. In not a few of those who show progressive loss in weight there has been a suppurative otitis without active symptoms. In others there has been a bacteremia, the only symptom being that of progressive loss in weight.

It is not infrequent to find miliary tuberculosis at autopsy where it was not suspected during life owing to absence of any fever.

*Pyloric Obstruction as a Cause of Marasmus.*—All malnutrition infants with persistent vomiting should be examined and observed to determine whether or not there is trouble at the pyloric outlet.

Uthelm<sup>1</sup> has made a careful study of a number of cases of athrepsia and demonstrated a greatly increased loss of food material as seen in the stools during the active stages. The loss may be as great as 26 per cent. of the food intake, but utilization of the food is much greater as improvement takes place in the infant's condition.

*Pathology.*—There is no lesion or set of lesions peculiar to infantile atrophy. The senior author has personally autopsied a large number of cases. There is often a strip of hypostatic pneumonia, perhaps a large area of atelectasis. Now and then the liver is fatty or shows fatty areas. The spleen, kidneys, and heart are pale. The stomach and intestines contain thick, sticky mucus, which when removed shows a pale, washed-out-appearing mucous membrane. Blood infections with the pyogenic cocci have explained the etiology in several recent cases.

*Treatment.*—*The Wet-nurse.*—An important factor determining the prognosis is the possibility of obtaining breast milk.

That a great majority of cases of simple athrepsia recover, and often recover promptly, making a most satisfactory growth when a wet-nurse

<sup>1</sup> Amer. Jour. Dis. Child., vol. xxii, pp. 329-350.

is secured, is proof, as above stated, that the condition, so far as relates to any peculiar systemic state or pathologic condition, depends more upon the nature of the nutrition than upon the patient. In securing a wet-nurse the physician's duties are by no means completed. The patient may not take kindly to the breast, and will have to be taught breast nursing. A great deal of time may be required in teaching older infants, those who have been on the bottle for seven or eight months. To this end various devices may have to be used. For the first nursing it is well to allow the child to go for an hour or two beyond the feeding time in order that his appetite may be voracious. It is advisable also to give the first few nursings in a darkened room with the person who has been accustomed to feeding the patient very near. Sufficient milk should be forced from the breast to enable the child to taste it. A little powdered sugar sprinkled on the nipple is a good means of increasing his interest. In some instances it has been necessary to cover the wet-nurse with a blanket or sheet, leaving only the breasts exposed; or it may be necessary to use the nipple-shield for a few days in order gradually to accustom the child to the change. We have yet to see a case in which success did not follow persistent effort. Often the nurse's milk will not agree at first; but this is not surprising and need cause no discouragement. Breast milk ordinarily is a much stronger food than the child has been accustomed to, and it may produce vomiting, colic, or diarrhea. When indigestion follows, the nurse's milk should be modified by giving the baby weak barley-water or plain boiled water, before the nursing in case he nurses well, or after the nursing in case he nurses poorly. One or two ounces of breast milk at a feeding is all that these patients can be expected to take during the first few days. The amount obtained may readily be determined by weighing the patient, without the trouble of undressing him, before the nursing, and then weighing him at intervals of from three to five minutes after the nursing has commenced. One ounce of breast milk is practically 1 ounce avoirdupois. These children, if not too weak, will take greedily almost anything from the bottle. The addition of 1 or 2 ounces of barley-water or plain water dilutes the milk and renders it easier of digestion, and furnishes at the same time the necessary fluid for the child.

The most unpromising cases of marasmus are not to be despaired of nor the treatment relaxed, although the physician should be cautious in his prognosis. If the child is too weak or indifferent to swallow, the wet-nurse's milk may be expressed, diluted, and given by gavage. In many cases evaporated milk (p. 78) may be used successfully for marantic infants. It is much easier of digestion than fresh cow's milk, and is a temporary measure of much value.

*Illustrative Case.*—The most pronounced and the most hopeless recovery case coming under our personal observation was seen in consultation in one of the suburbs of New York. The child was four months old and weighed 5 pounds. He was emaciated to a skeleton, having weighed 8 pounds at birth. The temperature for several days ranged between 92° and 94° F. A trained nurse and an unusually intelligent mother were in charge. Because of doubt respecting the accuracy of the thermometer reading, different thermometers were used. The temperature was taken by the rectum. The attending physician had also taken it repeatedly, so that finally there was no doubt. The child was too weak to nurse. The breasts were accordingly pumped, and for each feeding he was given  $\frac{1}{2}$  ounce of breast-milk with an ounce of barley-water, to

which a few drops of sherry wine were added. This was given by gavage at two-hour intervals. He was wrapped in flannel and wool and surrounded with hot-water bottles. The food was retained and digested. In four days he could nurse, and was allowed to take a small amount from the breast and finish the meal with barley-water. The temperature gradually rose to the normal. More breast milk was allowed as he proved able to care for it, and the child made a perfect recovery, weighing 18 pounds when he was nine months old. This case demonstrated that a marasmic child is never a hopeless case until he ceases to live.

Unfortunately, very few marantic children can have the benefit of a wet-nurse, but without a wet-nurse many of these cases are not hopeless. The use of evaporated milk (p. 78) and malt soup (p. 78) will furnish a satisfying diet in not a few instances. Marasmus is, of course, a very serious condition, but the chances are much better in a reasonably good home than in a hospital, where the story is often as follows: The patients take the modified milk or whatever is given them without inconvenience. The stools may be offensive if cow's milk is given, or there may be constipation, or the stools may appear perfectly normal. As a rule, there is no serious diarrhea or any other evidence of an acute inflammatory process in the intestine. However, in spite of fairly normal stools, the patient grows thinner and thinner. After a time all food is refused, gavage is used as a last resort, and the child finally dies. The autopsy shows nothing but pale organs, with perhaps a strip of hypostatic pneumonia. Now and then one of these cases in a children's institution or in a hospital recovers without a wet-nurse, but it is the exception proving the rule. Put these athreptics on a wet-nurse, as one should do at every opportunity, and many of them will thrive in spite of the well-known unfavorable influence exerted by institutional life upon the very young. In addition to putting the athreptic baby on the wet-nurse, his stomach should be washed once daily and he should live out-of-doors. In the cases of extreme dehydration transfusion, hypodermoclysis or intraperitoneal infusion (p. 850) may be employed.

*Outdoor Life.*—Next to the wet-nurse we know of no agent fraught with so much good as is outdoor life. The season of the year exerts considerable influence on the prognosis. The athreptic bears the heat and humidity very badly, and the early summer mortality of all large cities is materially increased by these children, who wilt and die in institutions and tenements with the first two or three days of continuous hot weather. Parents residing in a large city who can so afford should send such children to the country not later than June 1st, to return, in this latitude (New York City), not earlier than October 1st. During the day the child should be on a porch or in the shade continuously. At night the windows of his sleeping-room should be wide open. During the cooler months, if the child is too ill to be taken out-of-doors, he should have from morning until evening a continuous indoor airing (p. 838). The sleeping-room should always communicate with the open air. The roof-garden in large cities is a most valuable aid in the management of athreptic children.

*Cases in Which a Wet-nurse is Impossible.*—One phase of this most interesting and important subject has not been touched upon. We refer to the athreptic infant of the tenement, and those others in private life for whom a wet-nurse is impossible. They furnish by far the largest number of our marasmic patients. Perhaps the most frequent

error in the management of these cases is an endeavor to select at the start a food for the child to *thrive* upon. In doing this, almost invariably a stronger food is selected than the child is capable of digesting, and he is made worse by the attempt. Our ultimate object in treating these infants will be more readily attained if, at first, we attempt only to supply a food upon which they *can exist* without loss in weight. The number of calories necessary for an athreptic child is not great. It must be remembered, furthermore, that we are not dealing with a case of infant feeding as the term is commonly understood. True, we are feeding an infant, but a sick infant, and the methods of feeding used for the comparatively well do not apply here in all respects. The problem of nourishing these children is to be considered from two standpoints—that of the food and that of the baby, with special reference to the organs of digestion. The stomach, in many of these infants, is dilated, with a consequent lack of motility. Residual undigested food remains long after feeding. There has been a constant fermentative change, with the production of lactic and butyric acids, resulting in local changes of an inflammatory nature in the mucous membrane of the stomach, so that not only must the organ be prepared for the food, but the food must be adapted to the stomach capacity, and when this is done—when both requirements receive due consideration—we are much more likely to succeed.

*Stomach Washing.*—In all of these cases for the first few days of treatment it is advisable to wash out the stomach with sterile water, regardless of the presence of vomiting and regurgitation and regardless as to whether the child is bottle fed or breast fed. It is often surprising to note the amount of thick mucus and undigested food that will be washed from a stomach from which there has never been vomiting. The daily washings enable the child to take more and stronger food. It may even be necessary to continue the washings for days. They may first be discontinued when the water siphons clear and without mucus. They should be repeated if there are indications, such as regurgitation of sour water or mucus or loss of appetite. In one case in which there was chronic gastritis with athrepsia washings were continued at gradually lengthened intervals for six months.

*Temporary Feeding.*—If the case is one with pronounced stomach involvement, a 3 per cent. milk-sugar solution should be given for twenty-four hours in quantity suitable for the age and size of the patient. The following day barley-water No. 1 (see Formulae, p. 94) is to be given, to which sugar is added to make the mixture 5 per cent.

*Cow's Milk.*—While it is doubtful if the child can take cow's milk, after this period of stomach rest and stomach washing it may be attempted. Two drams of as safe milk as can be obtained are added to every second feeding of the barley-and-sugar-water. If it agrees, after a day or two, 2 drams are added to every feeding, with a gradual increase of a dram every two or three days. The intervals of feeding, for children under one year of age, may range from two to three hours. It is rarely advisable to feed even the most delicate athreptic oftener than once in two hours. If the milk can be retained and assimilated in the strength of one-fourth milk and three-fourths barley with 5 per cent. sugar, or if an equal quantity of milk and sugar-water alone is found to agree,

the child will begin to grow and general improvement will rapidly follow. If the cow's milk is not well borne, skimmed milk or a weak cream mixture— $\frac{1}{2}$  dram of cream to a feeding—may be tried. It is practically impossible to have whey made properly outside of a hospital laboratory or an intelligent home. In using whey one may give it in quantities suitable to the age of the patient. The prescribing of cream among the poor is a hazardous procedure, for the cream may be old, improperly cared for, and swarming with bacteria. If there is a tendency to looseness of the bowels, the diarrhea is thus made worse. Cream mixtures rarely succeed as foods for athreptic children. Cream should be prescribed only among those who can properly care for it (p. 66). Evaporated and unsweetened milk may, however, often be used with success.

*Sweetened Condensed Milk.*—For the out-patient athreptic and for some in better circumstances the much abused condensed milk fulfils a useful function. It is one of the cleanest foods we can give the dispensary baby. It is the cheapest, the most easily kept, and the most easily digested milk that can be furnished him. Consequently, when ordinary milk feeding is impracticable or when it disagrees, one may give condensed milk, beginning with  $\frac{1}{2}$  dram, which is added to the barley-water or to the plain water for every second feeding, later to every feeding, increasing the quantity gradually as the child shows an ability to digest it. The patient must be seen frequently and the stools carefully examined in order that an increase in the food strength may be made as soon as conditions allow. The mother should be told to bring the napkins to the dispensary, and the child should be weighed at each visit, every second day. It is most gratifying to see how well some gain in weight, not because they are getting an ideal food by any means, but because the food used temporarily fits the case. Condensed milk is thus used as a stepping-stone to something better. When the child has taken condensed milk with benefit for a month or six weeks, ordinary milk is attempted if the time of the year is between October and the following June. After June 1st one may continue with condensed milk, as the possibility of some degree of anemia and rachitis as the cooler months approach is to be preferred to the risk of attempting cow's milk feeding, with poor milk, in the hands of an overworked or ignorant mother.

In beginning the use of ordinary milk, in order to avoid sudden radical changes it is well to replace one feeding of the condensed milk mixture daily with one feeding of a weak plain milk mixture. In some cases this will produce illness and must be stopped; in others it will be well borne. When it is found to agree, two feedings should replace two condensed milk feedings daily. In this way, by increasing by one the number of plain milk feedings every third or fourth day, entire plain milk feeding may safely be inaugurated. The strength of the plain milk should not, of course, correspond to that suggested for well babies. To a child of six months a three-month formula may be given. As the child improves, the strength of the milk may correspondingly be increased. In this way a great many tenement athreptics have been successfully treated.

Some children will be able to take and properly care for only two plain milk feedings daily; others will take every second feeding of plain

milk. One patient aged fourteen months would take two plain milk feedings daily with comfort, but when the third was given he was invariably made ill. Some will not be able to take a particle of ordinary milk. When this is the case, the condensed milk should be combined with a gruel, such as oatmeal, which contains a high percentage of protein. These cases may also be given beef juice at a very early age. Pure cod-liver oil, from 15 to 30 drops of which may usually be taken three times daily without disturbance, may also be given.

The tenement athreptic is to be given the benefit of as much fresh air as possible. He is also to be given the advantage of the daily tub-bath and the oil rub. For further suggestions, see *Common Digestive Disorders of Infancy* (p. 99).

### MALNUTRITION IN INFANTS

Malnutrition may profitably be considered as the first stage of marasmus. Every child with marasmus must first have undergone a longer or shorter period of malnutrition. Victims through inheritance, such as those who are constitutionally inferior, the offspring of the tuberculous, and the remotely syphilitic, often show signs of malnutrition, are inherently weak, and possess low vital resistance. Frequent child-bearing may be a predisposing factor—the fourth or fifth child, when the pregnancies have been close together, may show general lack of vigor.

**Symptoms.** With malnutrition the infant may be 3 or 4 pounds underweight, his gain being slow and irregular; often inappreciable, or, at best, a few ounces a week. The muscles are soft, and if the condition persists, bone changes, indicating rachitis, soon appear. The child is pale and usually thin. There is a secondary anemia. Dentition is delayed. The hands and feet are apt to be cold and the skin is dry. Excoriations of the buttocks and intertrigo are of common occurrence. The patient shows evidence of indigestion by a distended abdomen and stools that are far from the normal. There may, however, be no intestinal derangement whatever, the malnutrition being due to the fact that the child's diet for months has consisted of food that did not contain the nutritional elements required, or the fact that he was unable to utilize that which had been given him.

*Illustrative Case.*—A case due to high fat feeding was that of a male, six months of age, weighing 13 pounds, a resident of a New York suburb, where the conditions are most healthful. His fontanel was slightly depressed, the muscles were soft and flabby, and the ribs were beaded. The child had lost his appetite and suffered from constipation. A history of the feeding showed that he had been getting a cow's milk mixture containing approximately 6 per cent. fat, 4 per cent. sugar, and 2 per cent. protein. His indigestion, loss of appetite, and constipation was unquestionably due to the high percentage of fat. The energy exerted in digesting the food almost counterbalanced the benefit derived from it, the result being a very slow gain in weight.

**Diagnosis.** Upon assuming the care of one of these infants one must invariably make a very thorough examination in order to determine whether there are other factors than that of imperfect gastro-intestinal function. Following the usual physical examination, which should include the ears, the urine should be examined; there should be a von Pirquet test for possible tuberculosis; there should be a blood-count to learn the degree of anemia and the possibilities of occult pus, and if the case

is very persistent, a blood-culture should be made, as it not infrequently occurs that a hitherto unsuspected cause of malnutrition may be bacteremia. In hospital cases the pneumococcus, the streptococcus, and the staphylococcus have been found in the blood of malnutrition babies.

**Treatment.**—The management of malnutrition due to most causes consists in correcting the digestive errors, in using castor oil or calomel with stomach washing, and in adjusting the food to the child's requirements and digestive capacity.

These cases are all difficult to feed satisfactorily.

The problem which confronts us is often most difficult of solution.

Chapin is an advocate of the use of cereal gruel as a milk diluent, claiming that the milk is rendered more easily digested because of the presence of the starch. Others believe that the use of alkalies and antacids renders the milk easier of digestion. In very few of these difficult cases, however, do the ordinary cow's milk dilutions and adaptations produce satisfactory results. The majority of such infants cannot digest cow's milk unless it is materially changed by other than mechanical methods. It is also to be remembered that in difficult feeding the food helps to solve only a part of our problem. The physical condition of the child, his care, and particularly the containing and working capacity of the stomach, are matters requiring thought and adjustment.

A difficult feeding case requires:

1. Fresh air. Indoor airing in winter or roof treatment—cold air.
2. Clothing sufficient to insure warmth; particularly must the extremities never be cold.
3. Quiet—absence of handling other than is necessary for cleanliness. Quiet is particularly necessary if there is a tendency to regurgitation or vomiting.
4. Stomach washing—a most useful procedure, even when there is no vomiting. A stomach lavage cleans out the mucus and undigested material from the stomach, which is very apt to be enlarged and of defective motility. The lavage may be used daily for a week or less frequently—perhaps every other day. In some cases one or two washings suffice. In others lavage is continued at intervals determined by the condition—rarely longer than three to four weeks.
5. Position. In the cases with habitual regurgitation the position in which the child rests in the crib is important. Smith and Le Wald<sup>1</sup>—as a result of six Roentgen ray studies of infants after feeding—advise the erect position after feeding, the child being held against the nurse's shoulder for a few moments. When the child is placed in the prone position, the head of the crib should be considerably elevated. Both of these proceedings aid in the expulsion of gas, which they proved is swallowed during the act of nursing.

Two methods that have been particularly useful in nourishing these infants are *malt soup feeding*, and the use of appropriate dilutions of *evaporated milk combined with a cereal diluent* containing a low percentage of sugar. Both methods have been discussed (p. 78).

For many infants dry milk has proved easily assimilable when carbohydrate and fat have been poorly tolerated.

<sup>1</sup> Amer. Jour. Dis. Child., vol. ix, pp. 261-282.

For the more advanced cases of malnutrition in infants the treatment outlined for actual marasmus is indicated (p. 106).

### IDIOSYNCRASY TO COW'S MILK

Rare cases are encountered in which there exists an intolerance of cow's milk or any form of food which contains cow's milk, including condensed milk and all the malted foods containing desiccated cow's milk. In such cases the use of any of these substances as foods produces illness of such an alarming type as to necessitate prompt discontinuance of the food. The only hope for infants thus constituted is a wet-nurse.

This extreme reaction to milk constitutes what is known as milk allergy, or milk protein sensitization.

Instances of breast milk allergy are reported.<sup>1</sup>

*Illustrative Cases.*—*Case 1.*—An illustration of allergy to milk foods occurred in the senior author's own family. A healthy, full-term female infant whose birth weight was 7 pounds, 12 ounces was nursed by her mother with indifferent success for two weeks, when the supply failed absolutely. Feeding with a most carefully prepared modified cow's milk was begun. The child refused the food, and 2 drams were forced. This was followed in a few moments by vomiting and retching, which continued at intervals for twenty-four hours, with collapse and exhaustion to an extreme degree. A wet-nurse was secured, the breast was well taken, and the milk agreed perfectly. In three days the wet-nurses' milk began to fail and was entirely lost in twenty-four hours. A weak dilution of condensed milk was then given, with results almost as disastrous as before. The child at this time weighed 6 pounds, 4 ounces, and showed all the symptoms of early marasmus. A second wet-nurse was secured, whose milk also failed in a few days. Before her departure, however, a third nurse was engaged, on whose milk the child thrived most satisfactorily. When the patient was three months of age a weak cow's milk mixture, prepared by the Walker-Gordon Laboratory, was given. The child refused the food, and  $\frac{1}{2}$  ounce was forced. As on the previous occasion, vomiting with prostration bordering on collapse was the outcome. Vomiting continued at frequent intervals for twelve hours, and the breast was refused for twelve hours longer. The giving of cow's milk was not again attempted until the child was nine months old, a wet-nurse meanwhile being employed. The child was then strong and vigorous, and weighed 18 pounds. Two drams of cow's milk mixture suitable for a baby three months of age were given. This produced nausea and vomiting, as though an equal quantity of syrup of ipecac had been given, but no more serious disturbance. At this time the wet-nurse's milk began to fail. The breast milk nutrition was supplemented by the use of cereal made into a thick gruel. Oatmeal in the form of a gruel to which sugar was added was given, largely because of its high protein content. Beef juice, scraped beef, and pure cod-liver oil were also given about this time. At the completion of the first year a portion of a soft egg was added to the diet. Zwieback and bread crusts soaked in sugar-water were also used. These solid substances were given two or three times a day, after which the child was nursed. Pure cod-liver oil was given almost continuously during the second year. Butter-fat could be taken without inconvenience at one year.

Following out the above lines of treatment, the child was weaned when thirteen months of age. She was then fed with an entire absence of cow's milk from the diet. When six years of age her weight was 55 pounds, height 48 inches. She was normal in every respect, but 6 ounces of milk given at one time would produce a coated tongue, foul breath, constipation, and excessive irritability which was entirely foreign to her nature. At the twelfth year the intolerance for milk was entirely overcome.

*Case 2.*—The young mother of a vigorous, eight-month-old breast-fed girl determined to wean the baby. The family physician prescribed a suitable formula. The child refused to take the milk mixture. A small quantity was taken and immediately vomited. After further unsuccessful attempts at feeding 2 ounces were forced. This was at 10 A. M. The child did not vomit, but passed into a condition approaching collapse. A few hours later she presented the appearance of a case of severe intestinal intoxication. She was very apathetic, but could be aroused with difficulty. The pulse was

<sup>1</sup>Weil, Jour. des praticiens, September 20, 1920, and Médecine, August, 1920. Starck: Anaphylaxis to Breast Milk, Archives de médecine des enfants, Paris, September, 1921.

small, very soft, and thready. The respiration was superficial, but not rapid. The eyes were sunken, the skin blanched. In spite of active stimulation and external heat the child grew gradually weaker, making but temporary response to stimulation, and died seventeen hours after the milk had been given. The case was one of anaphylactic shock from the milk protein. Of many cases of allergy to foods, this case alone proved fatal.

*Case 3.*—A boy treated for colitis gave a history of allergy to milk. The placing of a few drops on his tongue would be followed immediately by intense general urticaria.

*Case 4.*—A vigorous, nine-month-old breast baby was given a feeding of cow's milk and vomited it at once. In a few days another feeding was attempted. The child took only a swallow or two of the food, but at once developed general urticaria. The ears suddenly became several times their normal size, and the eyelids swelled and closed the eyes. The respiration became greatly impeded through edema of the glottis to the extent that the mother feared the child would suffocate. Six hours later the voice was still hoarse and croupy. Three weeks later 5 drops of milk were placed on this baby's tongue. In three minutes he vomited and became decidedly pale; in a few minutes more he vomited again. This was followed by hiccup, which lasted until he left the office one-half hour later. The child, months afterward, was still so sensitive to milk protein that a vaccination with milk would produce at the site of the scarification a large urticarial wheal. The wheal was also produced by egg-white.

*Case 5.*—An eight-year-old perfectly developed girl had never been able to take cow's milk in any form. The cutaneous test induced a marked reaction, and all attempts at immunization failed.

### SCURVY (SCORBUTUS)

Scurvy in infants was first described by Glisson in 1651. It was not well recognized, however, until Möller described it again in 1859, viewing the disease as an acute type of rachitis. Ingelev, of Sweden, recognized a case of apparent infantile scorbutus in 1873, and in the period 1879-82 Cheadle reported several cases. In 1883 Sir Thomas Barlow was able to give a clear demonstration of the clinical features and pathology of this disease, and thenceforth reports of its occurrence were frequent. Infantile scurvy, or Möller-Barlow's disease, is a very definite affection, and, although the term "scurvy-rickets" still persists, this serves only to emphasize the frequent coexistence in a patient of the two essentially distinct conditions.

**Etiology.**—The age incidence is significant. In a large number of cases we have seen but two over eighteen months of age; the first patient was four years old, the second an idiot slightly older. Occasionally scurvy occurs in infants under six months of age, but this is unusual. Our youngest case was that of a nursing baby three weeks old. In this infant there was a separation of the epiphyses at both wrists.

The immediate physiologic cause of the hemorrhagic condition has not been discovered. It seems proved that there is some constitutional error, due to nutritional defect, which accounts for the development of the actual disease.

In most instances the nutritional defect may be ascribed to the use of cooked foods. The well-known collective investigation of the American Pediatric Society established the influence of foods that had been subjected to the influence of heat. Thus, 10 patients were entirely breast fed, 4 were getting raw cow's milk, 116 were on pasteurized, sterilized, or condensed milk feeding, 214 were on proprietary foods. So pronounced a factor is cooked food in the production of scurvy that in all cases so fed we invariably give orange juice, 2 or 3 teaspoonfuls daily.

The heating of milk invariably removes something from it which is necessary for the prevention of scurvy; nevertheless, such cooking does

not interfere with its nutritional properties. This has been demonstrated in hundreds of cases. The undetermined factor is the antiscorbutic vitamin or vitamin C, which is extremely thermolabile in an alkaline medium. Vitamin C is present in greatest concentration in the citrous fruits.

Malnutrition is not necessary for the development of scurvy, neither is previous illness a factor of much consequence.

In scurvy there are probably alterations in the capillary walls which permit the diapedesis of the red cells. Wright showed that in this disease the alkalinity of the blood may be reduced to a point as low as 35/200 of the normal, and he regarded scurvy as a form of acid intoxication.

**Pathology.**—The two leading features in the morbid anatomy of scurvy are multiple hemorrhages and rarefaction of bone. Whether the atrophy in the bone is or is not a result of the intra-osseous extravasations seems uncertain. It is, however, believed that the rarefaction may occur primarily, independent of the hemorrhagic lesions. Although in some instances hematuria is the only prominent symptom, bleeding is usually not confined to any particular site, but may occur under the periosteum, in the bone-marrow, under the skin, under the membrane lining the serous cavities, or from the mucous surfaces. In the bones the most severe lesions are found in the neighborhood of the epiphyses. The lymphoid marrow cells and the osteoblasts are diminished in number, and there is increased porosity of the cancellous tissue. Fractures of the ends of the long bones are exceedingly common. In some cases there is separation of the epiphyses. In one case there were four so-called fractures—two at the shoulder-joint in each humerus, and two at the hips in each femur. Beneath the periosteum are extensive extravasations of blood, which frequently become organized into firm layers of clot. In rare instances hemorrhages occur within the joints.

**Symptoms.**—The first sign noticed is that of evident pain upon manipulation of different portions of the body, most frequently one of the legs. The complaint is that the child cries when the napkin is changed, or when he is being bathed or dressed. Further, instead of freely moving his arms and legs, he allows one or more of his limbs to rest, while the others may be moved freely.

In advanced cases all the limbs may be involved, and the child makes no attempt at even changing the position of a limb, and cries vigorously when such a change is made. The position taken is that of outward rotation of the extremity affected.

In advanced cases the involved joint or joints will be swollen. The swelling may involve the entire limb. In a case occurring at the Babies'



Fig. 8.—Bilateral subperiosteal hemorrhagic extravasations in advanced scurvy. (New Rochelle Hospital.)

Hospital the leg, from above the knee downward, was twice the size of the unaffected leg.

Upon manipulation the parts are excruciatingly tender. Repeatedly mothers complain that the child who previously has enjoyed attention in the way of handling and holding, prefers to lie quietly in his crib and apparently fears to be touched.

While the long bones are usually involved, the other bony parts may be affected. In two children the ribs, spine, and scapula were affected. The extremities were normal. Both infants were about nine months of age. They cried vigorously when they were lifted by placing the hands around the body under the arms. The diagnosis of scurvy was proved by the quick and complete response to orange juice and the use of uncooked food.

A few ecchymotic areas may be found on the skin, but this is unusual.

Too much emphasis is placed upon this symptom, which is not an early manifestation and may not appear for two or three or more weeks after the first manifestation of the local lesion in the limbs. If the condition is not recognized, submucous bleeding almost invariably appears, and is characteristic, providing the child has teeth in the upper jaw; the gums in the lower jaw are rarely involved. The gums are swollen, edematous, and bleed readily. Over teeth about to be erupted blood blebs of a dark bluish color may be seen. In the absence of teeth the gums are usually normal. In a very few cases a slight bluish discoloration may be noted. It is only in the very advanced cases that the lower gum and teeth will show involvement.

Hematuria to a slight degree is present in most cases. In a few instances it has been severe, showing macroscopic blood. Blood in the stools is of very rare occurrence.

An unusual form of hemorrhage is that occurring in the orbit and producing protrusion of the eyeball. Exophthalmos of this type cured by orange-juice therapy has been reported.

**Prognosis.**—The prognosis is very favorable. All cases recover if a reasonably early diagnosis is made and proper treatment instituted. If there is simply an involvement of a joint, of short duration, the child may be apparently well in two to five days. In cases in which extensive lesions have formed, two or three weeks or more may be required for complete recovery. The longest time under treatment in our cases was three months.

*Illustrative Case.*—A baby eighteen months of age was taken to Dr. V. P. Gibney, who recognized the condition at once and referred the child for treatment. The child had been treated for rheumatism for three months. All four extremities were swollen to twice or three times their natural size, and were swathed in bandages, each saturated with a different lotion or liniment. In this way each liniment was to be tested out and the one that served best was to be selected for all the limbs. The odors emanating from the child were those of a chemical establishment in active operation.

After all previous local applications employed and those in use had failed, the child, with complete paralysis of all the extremities, was considered a suitable subject for the orthopedist. In addition to the symptoms described, the gums were bleeding freely. In this case, the most severe we have seen, the progress toward improvement was very slow. There was much extravasated blood to be absorbed and infractions—how many one could not determine—to be healed. Resolution was, however, eventually complete.

Studies of the bones in scurvy with the aid of the x-ray show that even in mild cases complete restoration of the normal bone condition is a matter requiring many weeks, even after the patient is, to all appearance, well.

**Differential Diagnosis.**—Scurvy in infants was formerly most frequently confused with rheumatism. The age for scurvy—under eighteen months—is not the age for rheumatism. Scurvy is a disease of early infancy, and rheumatism, a disease of childhood. In rheumatism fever is a usual symptom. In scurvy fever is unusual. From poliomyelitis scurvy may be differentiated by the acute pain upon manipulation and the presence of the knee-jerk. Specific epiphysitis may be mistaken for scurvy if the upper extremity is involved. The absence of other signs



Fig. 9.—Extensive hemorrhage about the right femur due to scurvy in a neglected six-year-old idiot.



Fig. 10.—Hematoma about right femur. (Same case depicted in Fig. 9.) (Bellevue Hospital.)

of syphilis, and a negative Wassermann test, will render a differentiation possible. Further, in any case which is doubtful, the use of orange juice will, in a few days, through relieving the symptoms of scurvy, determine the diagnosis. This is a perfectly innocent procedure upon any evidence of pain in any of the limbs.

Supposed trauma, such as a sprain or a fall, is the interpretation often applied to the symptoms of scurvy. Trauma in infants is most unusual, but possible, and the orange juice treatment test may be required to differentiate.

Among the conditions simulated by severe scurvy are to be mentioned osteomyelitis and new growths of bone.

In all doubtful cases the x-ray is essential.

**Treatment.**—*Dietetic.*—The first step in the treatment is to supply

fresh milk for the child, diluted, if necessary, to meet the digestive capacity. Cases in which the diagnosis is made early often recover without the aid of any other measure upon a change from sterilized milk or infant foods to raw milk. Inasmuch as the disease is a most painful one, every means possible should be employed toward furnishing early relief. If orange juice is not well tolerated, beef juice may be given, or the juice of any ripe fruit, suitably diluted. The orange juice very exceptionally disagrees with the digestion. A scorbutic child who has never tasted orange juice will take it greedily and beg for more. One teaspoonful may be given at two-hour intervals, 1 ounce at least being given ordinarily in twenty-four hours.

Among other antiscorbutic foods, lemon, tomato, potato, and even turnip are particularly rich in the essential vitamin. Recent investigations have shown that canned tomato juice and even dried orange juice may still retain their antiscorbutic potency.

Unless the case is an advanced one, with extensive subperiosteal hemorrhages and separation of the epiphyses, relief will be noticed in twenty-four hours and an entire cessation of symptoms in from five to seven days. We have seen a few cases entirely relieved at the end of seventy-two hours of treatment. These cases have been those in which the diagnosis was made very early, the only symptom being the evidence of pain during manipulation of the limbs in bathing or while changing the napkin.

The management of more severe cases is the same as that applied to those of milder type. Fresh food, with orange juice or beef juice, must be freely given. The patients should be handled very gently, and only when necessary, as the pain on manipulation of the involved parts is most excruciating. In cases of epiphyseal separation splints should be temporarily applied.

### RICKETS (RACHITIS)

Rickets was described by Whistler in 1645, and again in 1650 by Glisson. The disease has been more wide-spread in countries with cool, temperate climates than in tropical or semitropical regions, where the inhabitants live for the most part out of doors. Similarly, this disease shows a slightly greater tendency to develop during the winter than in the summer. Attempts to define the exact etiology of the condition for centuries uniformly failed. Most of the earlier theories have been reviewed by Dr. R. G. Freeman,<sup>1</sup> who found the disease most frequent in institution babies who were fed on breast milk supplemented by artificial feedings of condensed milk. In his opinion both unsuitable food and infection or toxemia from the alimentary tract may be influential causes.

Siegert in 1903 expressed the view that rickets was often hereditary, supporting his belief by observations of severe cases in the breast-fed children of rachitic parents. By other authorities, however, rickets of congenital origin was held to be improbable or in any event exceedingly rare.

Rickets is a chronic disease of nutrition. Its chief manifestations are in the bones during the growing period. It is peculiar, however,

<sup>1</sup> R. G. Freeman, *The Etiology of Rachitis*, *Archives of Pediatrics*, April, 1904.

in that a greater part of the structure which goes to make up the infant organism may be involved in the rachitic process, which is in effect a metabolic derangement of wide possibilities.

**Age.**—Rickets may occur at any age after the first month. It usually makes its appearance between the third and the twelfth months. Few cases develop earlier, and congenital rickets is questionable.

**Etiology.**—Italian and negro infants show a decided predisposition. A negro or Italian baby between six and twelve months of age in New York City without some evidence of rachitis is a curiosity.

**Environment.**—Much has been written regarding the etiology of the disease in its relation to climatic and unhygienic surroundings. While such surroundings may contribute to the result, we have yet to be convinced that as etiologic factors they are very important except when the conditions preclude outdoor life and sunshine. It is true that we often find rachitic children in unhygienic surroundings, but thousands of others who live under the same conditions do not have rachitis. A child fed on normal breast milk will endure and thrive in an environment that typifies "unhygienic conditions" (a popular term with writers).

Dick<sup>1</sup> has pointed out in detail that the countries of the globe most free from this disease are those where the inhabitants live most of the year in the open air and in communities free from fog and smoke. The Chinese are peculiarly free from rickets.

**Diet.**—In the treatment of several thousand rachitic children one fact is impressed most strongly: A child suffering from rachitis is suffering from nutritional errors as a result of improper feeding or inability to assimilate a suitable food. We have yet to see a case which will not improve when suitable nourishment can be given and assimilated, regardless of the age of the patient, provided, of course, there is no other disease. In children under one year of age prolonged feeding of the proprietary foods or sweetened condensed milk has long been considered the most frequent cause of the disease. The next most frequent cause is the feeding of a too strong cow's milk mixture, which produces indigestion and faulty assimilation.

**Rachitis in the Breast Fed.**—Breast-fed babies among the Italians and negroes often have mild rachitis, and an examination of the breast milk will invariably show a diminution of one or more of the nutritional elements—usually the protein.

**Illustrative Case.**—A nursing woman in the New York Infant Asylum had such a free flow of milk that a foster-child was given her to nurse. The children failed to thrive; each made a gain of but 2 or 3 ounces weekly; both developed rachitis, one in a marked degree. Repeated examinations of the breast milk showed it never to contain more than 1.5 per cent. fat, 4 per cent. sugar, and 0.5 per cent. protein.

We have time and again seen rachitis in breast-fed infants for whom the milk was adequate in amount, but deficient in nutritional elements. These cases will most often be seen from the seventh to the tenth month.

**After the First Year.**—After the first year fewer cases develop, but a late rachitis is by no means uncommon. The development of the disease at one year and after, as in the very young, has been distinctly traceable to faulty feeding and faulty assimilation.

<sup>1</sup> Lawson Dick, Rickets, 1922.

Not a few cases during the second and third years are due to *prolonged nursing*. The senior author has known just two mothers who could nurse their children, and substantially nourish them, by the breast later than the twelfth month. Usually when the breast furnishes the only means of nourishment after the ninth month, beginning rachitis will soon be noticed. The feeding after the first year of an exclusive diet of milk or of digestible starches is not infrequently a cause. Among the poorer classes children during the second and third years are almost always badly fed. The diet often consists of poor milk and poorly cooked

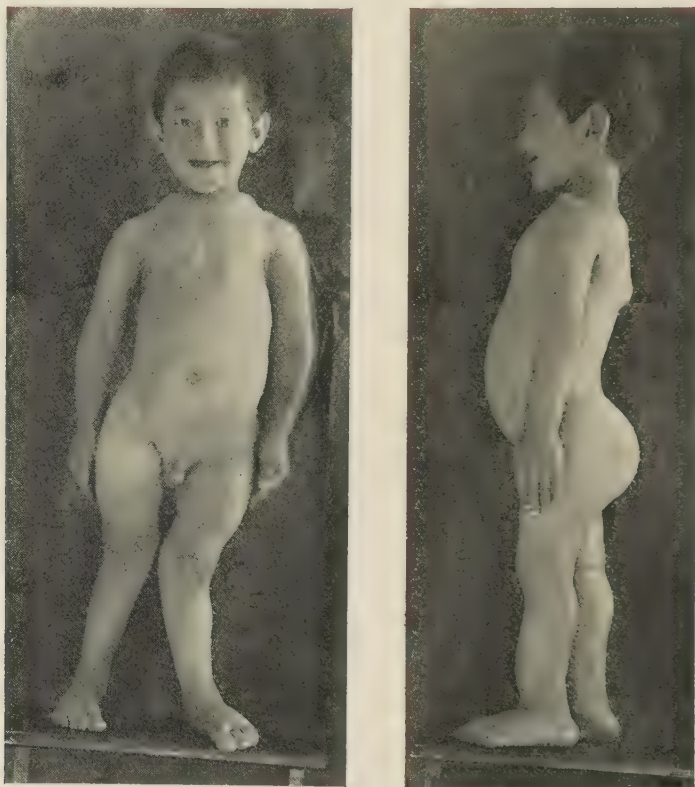


Fig. 11.—Late rachitic deformities: Bowing of clavicles, thoracic sulci, lordosis, knock-knee, saber tibia, flat-foot. (Seaside Hospital.)

starches. Children thus fed furnish no small proportion of our rachitic patients.

*Fat-soluble Vitamin.*—The outstanding factor in the causation of rickets is now affirmed to be the lack of the fat-soluble vitamin A, together with an abnormal calcium-phosphate ratio in the diet. Shipley, McCollum, *et al.*<sup>1</sup> have shown that, in the presence of a vitamin A deficiency, there are two forms of the disease, depending on the calcium phosphate imbalance, one of which is characterized by a low blood phosphorus and a

<sup>1</sup> Shipley, P. G., McCollum, E. V., Park, E. A., Simmonds, N., *Jour. Biol. Chem.*, August, 1921, p. 507.

normal calcium content; the other by a low calcium and a normal phosphorus. They believe that the low calcium type is associated with the occurrence of tetany, whereas the skeletal changes are related to an abnormal calcium phosphorus ratio. A large amount of research by various other observers is being contributed to this subject along the lines of metabolism studies and blood chemistry.

*Light.*—It has been definitely shown by Hess and his co-workers that, although the most important etiologic factor is dietetic, lack of sunlight, particularly the short ray ultraviolet portion of the spectrum, hastens very markedly the onset of rickets.

*Association with Other Diseases.*—The development of rachitis bears no relation to other disorders, except in its influence upon the nutrition of the patient. The coincidence of scurvy with rickets is not unusual.

*Theories of Pathogenesis.*—Deficiency of lime salts in the system, either as the result of poor food or faulty assimilation, has been long regarded as the cause of the disease, but evidence that rachitic subjects present the supposed variations from the normal, either in alkalinity of the blood or in lime elimination, is still incomplete.

Experiments in depriving young animals of fat have failed to render them rachitic. Attempts at bacterial inoculation have likewise afforded no convincing results.

Monti, of Vienna, was able to demonstrate a diminution in hydrochloric acid associated with an excess of lactic acid in the stomachs of affected infants, and he coupled with this discovery the observation that the disease was more prevalent among the breast-fed infants of Saxony, whose mothers received little salt in their food, than in communities where the individual intake of sodium chlorid was normal.

Hirschfeld demonstrated the existence of a vasoconstrictor substance in the serum of rachitic infants. To the presence of this substance he ascribed the frequent coexistence of simple rickets with tetany, eczema, and such catarrhal conditions of the mucous membranes as are indicative of a so-called exudative diathesis.

Sweet<sup>1</sup> has attributed the disease not to a deficiency of fat-soluble vitamin, but primarily to a lack of fresh animal food conveying suitable protein, and secondarily to endocrine dysfunction.

In the state of confusion arising from so many diverse theories we may summarize the results of clinical evidence in only a few facts: Rickets is infrequent in the breast fed unless colored or Italian; relatively infrequent amid good hygienic surroundings; rare before the age of three or four months, and uniformly absent from infants who have been taking and assimilating a substantial, well-proportioned food and live in the open air and sunlight.

*Pathology.*—The most obvious changes are in the bones. Here there is indeed a marked deficiency of lime salts. The formation of bone is interfered with not only at the epiphyses but also in the region subjacent to the enveloping periosteum.

In the epiphyseal ends of the long bones there is an excessive proliferation of the cartilage cells, and an abnormal vascularization of the zones of proliferation and calcification, which intervene between epiphysis

<sup>1</sup> Sweet, Brit. Med. Jour., December 24, 1921.

and diaphysis. The deposit of lime salts in the cartilaginous matrix is imperfect, and the solid cartilage undergoes a variable amount of



Fig. 12.—Epiphyseal evidences of active rickets in the bones of the legs. (Bellevue Hospital.)

absorption. As a result of these changes the epiphyses are softened and enlarged and the bones are subjected to varying deformities.



Fig. 13.—Multiple fractures of the bones of the forearm with marked epiphyseal enlargement and defects in calcification. (New York Nursery and Child's Hospital.)

Associated with the defective development at the epiphysis there is likewise incomplete formation of bone beneath the periosteum. This membrane is thickened, and the subperiosteal layer of bone, which nor-

mally undergoes calcification, is vascularized, soft, and deficient in calcium salts.

"The pathologic changes may be summed up in the statement that there is excessive absorption of the bone with impairment of the process of calcification."<sup>1</sup> When the disease subsides, the imperfect bone undergoes calcification and hardening, but retains the deformities previously acquired. The enlargement of the epiphysis characteristic of rickets is usually first apparent at the costochondral joints, which acquire the well-known beaded appearance suggestive of the title *rachitic rosary*. In the more advanced cases the thorax undergoes actual distortions, defined by the terms *Harrison's grooves* and *pigeon breast*. Curvatures of the spine and pelvic deformities which may be combined with lordosis

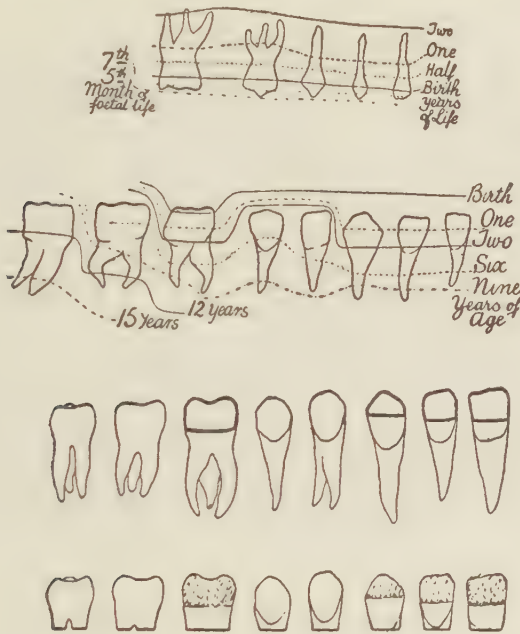


Fig. 14.—The teeth in rickets. (From Dick, "Rickets.")

are common. In severe cases the legs become curved, owing to the inability of the bones to sustain the weight of the body, and portions of the cranial vault may undergo a variable amount of absorption. Localized areas of thinness in the occipital and parietal bones are characteristic of the *craniotabes* of rickets. The affected skull is large and the centers of ossification of the frontal and parietal bones are marked by hyperostoses or bosses. In many instances the anterior fontanel instead of becoming closed at the twentieth month remains patent until the third or fourth year. The eruption of the teeth is uniformly delayed. Figure 14 shows the normal calcification of the two sets at various periods, the parts normally calcified in the first two years, and the commonest form of rachitic hypoplasia. (See p. 38.)

<sup>1</sup> Adami and Nicholls, *Principles of Pathology*, vol. ii, p. 1009.

Although rickets is fundamentally a disease of general nutrition, the lesions, apart from those occurring in the osseous system, are of relatively slight significance. The spleen is frequently enlarged; less often, the liver. The stomach and colon may be dilated. The muscles undergo wasting, slight degenerative changes, and a variable amount of fatty infiltration. The ligaments are relaxed. The blood shows the existence of a secondary anemia and a mononuclear leukocytosis.

The changes, aside from those of a secondary anemia, relate to the content of calcium and phosphorus in the blood. During active rickets either the calcium or phosphorus,<sup>1</sup> or both may be markedly decreased.

There is no question of the presence of a negative calcium balance in active rickets. In the older cases the calcium balance varies, but during convalescence there is a definite retention of calcium.

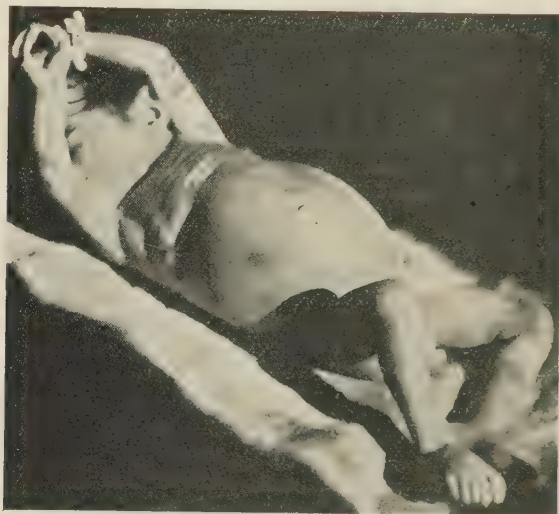


Fig. 15.—Thoracic deformity and enlarged abdomen of rickets. (Bellevue Hospital.)

**Symptoms.**—In a vast majority of the cases there are no symptoms depending upon the presence of the disease. There may be sweating of the head, restlessness, constipation; but these symptoms are also present in cases which show no rachitic change. There is usually malnutrition, and yet malnutrition may be present without rachitis. Rachitic children are unusually susceptible to catarrhal conditions of the respiratory tract and they have a weak resistance to infection of the intestines; yet, again, we find these conditions in children who do not have rachitis. In rachitic children there is pronounced lack of nerve balance, and this occurs in children who do not have rachitis. All these conditions are present in rickets, and as a symptom-complex they point to rachitis. Such symptoms, therefore, are not diagnostic without further corroboration.

Most of the conditions enumerated may be considered secondary to, rather than characteristic of, the disease.

<sup>1</sup> Howland, J., and Kramer, B., *Amer. Jour. Dis. Child.*, 22, 105, August, 1921.

So far as the pathognomonic symptoms are concerned, which means the conclusive manifestations of a disease, there are none.

The signs proving rachitis comprise the physical appearance of the child, the findings upon physical examination, and the evidence demonstrated by the x-ray and by postmortem examinations.

**Diagnosis.**—In a well-marked case inspection shows a condition that is seen in no other disease. There is the large head, cuboid in shape, flat on the top, due somewhat to the exaggeration of the frontal and parietal eminences. The beading of the ribs stands out plainly. The chest is narrow, retracted at the sides, and increased in the anteroposterior diameter, producing the so-called pigeon breast. In pronounced cases there often is an axillary groove extending the length of the chest. A rare deformity is the funnel chest, in which there is a marked retraction of the lower portion of the sternum, greatly decreasing the anteroposterior diameter at this point, with a corresponding increase in the lateral diameter.

The epiphyses of both the upper and lower extremities are enlarged, and there is a decided outward curvature of the tibia. There may be anterior bowing of the femur. The radius and ulna may also show

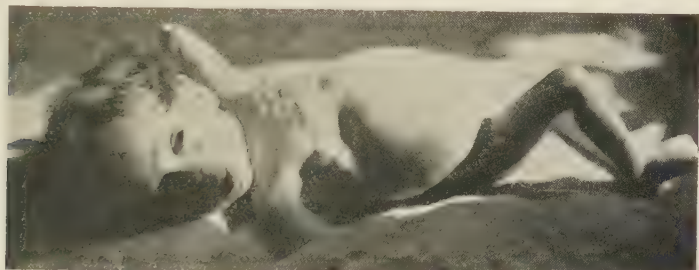


Fig. 16.—Rachitic head, Harrison's grooves, and "pot belly." (Bellevue Hospital.)

curvature, but this is less usual. Knock-knee is present in a comparatively small number of cases.

The child has a pot belly, often with umbilical hernia. The liver and spleen are enlarged.

Physical examination reveals a large fontanel, two or three times the size normal for the age. Dentition is delayed; repeatedly infants of a year and over will not have erupted a tooth. Craniotabes, which consists of soft, compressible areas in the skull showing deficient deposit of bone-cells, is present in many young rachitic infants.

A non-angular posterior spinal curvature involving several vertebrae will be found in a majority of the patients under fifteen months of age. This is due to muscle and ligament weakness, as will be proved by suspending the child by the arms, when the curvature will usually disappear. This straightening may not completely take place in older children, in whom the deformity has existed for several months. Further, in older cases there may be associated lateral and rotatory curvatures.

The clavicle may show thickening at the ends, and in severe cases there is frequently seen an increase in the anterior curve.

Rachitic children will be found abnormal in other respects. There is usually a secondary anemia. They possess poor resistance to bacterial infection, notably pneumonia, and when such infection or, in fact, any disease occurs the chances of recovery are less than in a normal individual. The vital resources are of a low order. Convulsions may occur upon slight irritation. The digestion is rarely up to the normal for the child's age.

It is to be understood that in this description we have been considering a well-marked case. Hundreds of children show varying degrees of mild rachitis in which the conditions may in no way compromise the individual. Further, it must be appreciated that not every case shows the even distribution of the lesions enumerated. There may be cases with bowed legs or knock-knees, spinal deformity, or enlarged cranium, in which one of the conditions mentioned may be the only sign of consequence.

**Differential Diagnosis.**—That confusion arises in differentiating rachitis from cretinism, mongolianism, and hydrocephalus is demonstrated in consultation practice. A clear mental picture as to what constitutes mongolianism, cretinism, and rachitis would eliminate confusion without the assistance of a consultant. A differentiation, however, between the large, rachitic head and one due to an acquired hydrocephalus or to a mild degree of congenital hydrocephalus, is not a simple matter, for the reason that when there is hydrocephalus there is usually rachitis. An immediate diagnosis is impossible. It is not unheard of for even competent neurologists to ask for time for further observation before making a diagnosis. The further observation has usually included repeated measurement of the circumference of the child's head. A child's head increases in circumference from birth onward about as follows: During the first year, 4 inches, 3 inches of which is the increase during the first six months; during the second year, 1 inch; during the third year,  $\frac{1}{2}$  to  $\frac{3}{4}$  inch; during the fourth and fifth years,  $1\frac{1}{4}$  inches. When the rate of growth considerably exceeds these figures it is an indication of hydrocephalus. A prominent fontanel and ununited sutures indicate hydrocephalus. (See p. 550.)

Other diseases occasionally confused with rickets in making a diagnosis are scurvy, rheumatism, paralysis of central origin, chondrodystrophy, osteomalacia, osteomyelitis, and syphilis.

**Prognosis.**—The prognosis is favorable in so far as the immediate disease is concerned. In early childhood the negative calcium balance becomes reversed. Uncomplicated with intercurrent disease, all cases recover if properly treated. Indirectly, because of the susceptibility to infection and the lack of resistance, rachitis is a large factor in the mortality of the young. Cured patients suffer no inconvenience in later life. There is doubtless some shortening in stature; it is difficult to determine the effects in this respect, as there are no means of knowing what height the individual might have attained had he not had rachitis. In women at childbirth its baneful possibilities are made prominent in a narrow and contracted pelvis in which the sacral promontory approaches the pubis.

Coxa vara is characteristic of the rickets of late childhood and adoles-

cence. High arch palate and deviated nasal septum are finally to be noted as deformities in many instances—due to past rickets. The problem of prognosis is thus carried into adult life and deserves consideration in other spheres as well as that of pediatrics.

**Treatment.**—It will readily be seen from the foregoing that the treatment of rachitis resolves itself into the adjustment of the diet to the needs of the patient. As growth and normal development cannot take place without protein and salts, and as the history of our cases has shown that these elements, together with fat, are most frequently lacking in the diet of rachitic children, suitable feeding should be our first consideration.

*Diet of Infants.*—Artificial foods usually are deficient in both the fat and protein; therefore these foods should be discontinued. We have seen a vast number of cases that were on cow's milk feeding of such strength that it could not be assimilated. In such cases a properly adapted cow's milk formula is the only treatment required.

*Diet After the First Year.*—For those over one year of age not only should artificial food be discontinued and cow's milk given, but the cow's milk should be supplemented by a diet rich in nitrogen, composed largely of milk, scraped beef, soft-boiled egg, oatmeal, and wheat gruel. After the second year purées of beans and peas may be added to the dietary because of the large percentage of protein which they contain. The physician must remember that a diet as highly nitrogenous as the child can assimilate is to be given. Unfortunately, many rachitic children cannot take cow's milk in quantities sufficient to make it of real nutritive value because of inability to digest the fat, the milk being taken without inconvenience when a large proportion of the fat is removed. Skimmed milk contains at least 3 per cent. of the nutritional element much desired, the protein, and makes a valuable addition to the diet. If a dilution of the milk is necessary, oatmeal gruel should be used.

Many children of this class who cannot take a full milk diet will take 1 or 2 ounces of butter daily without inconvenience. It is advisable to give rachitic children a moderate amount of fat, as it aids in the production of heat and thus saves the tissues. Egg yolk is antirachitic.

*Specific Cod-liver Oil Therapy.*—Kassowitz, toward the end of the last century, advised the use of cod-liver oil. Since that time it has been abundantly proved clinically and experimentally, roentgenographically and chemically, that cod-liver oil in sufficient dosage cures rickets and produces healing in the lesions. This is probably due to the large amount of fat-soluble vitamin contained in it. Changes are demonstrable in almost all cases adequately dosed and under competent radiographic study within a month.<sup>1</sup>

Before the second year of age cod-liver oil is often a valuable addition to the dietary. In prescribing cod-liver oil we prefer to use the plain oil. In spite of the disgust adults have for cod-liver oil, children usually take it readily. The younger the child, the better the oil will be taken. To delicate children six months of age from 10 to 30 drops may be given three times daily after meals. From the sixth to the eighteenth month from 20 drops to 1 dram may be given three times daily after feedings.

<sup>1</sup> Park and Howland, Bull. Johns Hopkins Hosp., November, 1921.

After the eighteenth month from 1 to 3 drams may be given at the same intervals.

*Hygiene.*—Brine baths and oil inunctions aid materially and are of great value in improving the child's condition as a whole. The brine bath (p. 843), which is given at bedtime, is to be followed by an inunction of goose grease, unsalted lard, or cacao-butter. The goose oil or lard is preferred. At least 2 teaspoonfuls should be rubbed into the skin. The benefit derived from the inunctions is largely due to the massage. The rubbing should be continued for at least ten minutes. The muscles of the back and legs should receive special attention. In a few instances the animal fats act as irritants to the skin and produce a fine, papular eruption.

The rachitic child should have plenty of fresh air by means either of a fireplace or an open window. On stormy and very cold days he should be given an indoor airing (p. 838), being placed in his carriage or cart and wheeled about the room. To avoid drafts, the window or windows on only one side of the room should be opened.

Rachitic children are very susceptible to head colds and bronchitis; therefore, every means must be employed to prevent exposure. As creeping and playing on the floor are the most frequent methods of taking cold, the exercise pen (p. 839) is particularly useful in these cases.

*Drugs* are of little value except as they increase the appetite and the capacity for properly selected foods. The administration of phosphorus is without avail if the deficient diet is continued. Specific medication without proper food and a fair digestive capacity is valueless. With proper food and a fair digestive capacity medication is superfluous, and a child rapidly recovers without it.

We have used phosphorus extensively, and have yet to see a single case in which the beneficial action of the drug could be proved clinically. In giving phosphorus the oleum phosphori is the easiest and most convenient form for administration. One drop of the preparation represents  $\frac{1}{100}$  grain of phosphorus. To children under one year of age 1 drop may be given three times daily. To those between the first and second year  $1\frac{1}{2}$  to 2 drops may be given three times daily after meals.

*Heliotherapy.*—A mass of evidence is now available from numerous sources proving the curative action of the sun's rays in various diseases. Not only is the cure produced in the bone lesions of rachitic subjects much like that obtained under treatment with cod-liver oil but there is a similar improvement in the phosphorus content of the blood as the result of exposure to direct sunlight. Hess and Gutman<sup>1</sup> have demonstrated in addition that owing to the filtering out of certain of the actinic rays of the spectrum the passage of sunlight through clothing or window glass inhibits to a marked degree the beneficial action of ordinary sunshine. Finally it has been shown conclusively that satisfactory curative effects are to be obtained from the quartz mercury vapor light even in the absence of both sunlight and cod-liver oil.

*Treatment of Deformities.*—The deformities of the osseous system, particularly of the spine and long bones, may be prevented—the first, by keeping the child on his back a greater part of the time, and, if the de-

<sup>1</sup> Jour. Amer. Med. Assoc., January 7, 1922.

formity is well marked, by teaching him to sleep resting on his stomach. When a kyphosis is present the child should be allowed to remain in the upright position but a few moments at a time.



Fig. 17.—Saber tibiae of rickets. (Seaside Hospital.)

Deformities of the femur, tibia, and fibula occur long before the child attempts to stand, but too early use of the legs, while not necessarily



Fig. 18.—x-Ray appearance of bones of legs. Patient shown in Fig. 17.

a cause of deformity, may greatly aggravate the existing conditions. For this reason rachitic children should not be encouraged to walk or stand until they have been under treatment for three or four months.

Operative measures for the correction of bow-legs are better postponed until after the third year. If corrected at an earlier period the deformity is apt to return, and the late deformity may be greater than the original one.

The use of the braces to correct the deformity of the legs has been of but little assistance, and the use of braces and jackets of plaster of Paris in kyphosis is usually unnecessary. Rest, massage, and exercises directed to restoring power to the weakened muscles have been of value.

### III. CARE AND NUTRITION IN CHILDHOOD

#### THE FORMATIVE PERIOD

THROUGHOUT the first year of life nutrition constitutes the main problem in the program of human development. Habit formation has its inception and the adaptation of the growing organism to its environment is in a measure completed during infancy. The expression of individuality has only begun. During the period after infancy this new problem is presented and upon the harmonious combining of good guidance with free rein to the rapidly developing faculties that go to make up personality depends in no small degree the future of the individual.

In the succeeding pages an attempt is made to emphasize the opportunities existing during early childhood not only for the furtherance of good nutrition but also for the formation of habits essential to the well-being of all children irrespective of individual traits.

**Necessity of Method in the Management of Children.**—One whose work in pediatrics is among all types and classes of people cannot fail to be particularly impressed with the fact that some children are the source of an immense amount of trouble, while others of no better health or greater strength cause very little anxiety on the part of their parents. Children differ greatly as regards individual traits and disposition, but these can be fashioned to a great extent by proper management. The more spirited the child, the greater need of method in the care.

Many mothers are worn-out, nervous wrecks for no other reason than a lack of system in the management of the daily life of their children. Thoroughgoing and conscientious these women may be, but they represent that large number who have never been taught that certain functions and duties should be performed only at certain definite times every day.

Beginning at birth, the baby should be fed or nursed at definite times and at no others. Sleeping should never interfere with the nursing hours. The child should have time for undisturbed repose, and a midday nap should be insisted upon until the end of the sixth year. The definite time for meals, with properly selected food, should be continued throughout adolescence. The child should be bathed at a certain hour and aired at a certain hour. "Runabouts" should have their hours for play and should retire at a definite time every evening. Such a régime is conducive to perfect health, consequently to better growth and development and to a stronger manhood. It is idle to say that many parents, particularly among the poor, cannot conform to such requirements. The poor are just as anxious to do the best for their children as are the rich, and will do this to the best of their ability if reasons are explained to them. If they cannot reach the ideal, they will attain to a higher degree of efficiency by striving. The trouble ordinarily is not with the mother, it rests more with the medical adviser, who is largely responsible for the ignorance of the mother and the resulting harm to her offspring.

## EDUCATION

**The School.**—Education only in the narrow sense belongs to school. Long before the actual acquiring of book learning is begun habits of application, concentration, and simple reasoning processes are acquired. The degree of development of these faculties constitutes a better measure of mental capacity than knowledge of letters or even ability to read or recite.

Only exceptionally is there any need for school in the accepted sense of the term before the sixth year of life. Rearing a "good animal" is the first problem of the early years, and this does not preclude the fundamental training which has already been emphasized.

The kindergarten, of course, has its function in developing good habits, promoting association between children, in forming the school habit, and in relieving overworked mothers from responsibility at certain hours. This agency, nevertheless, is not to be regarded as essential to childhood.

As a means of dissemination of contagious disease during the danger period before the fifth year the kindergarten, when close supervision in this respect is lacking, is actually to be regarded with disfavor.

For all young children school sessions should be short and broken by recess periods. Single sessions should not postpone the noon meal for which inadequate lunch is too frequently substituted, and school work at home should be prohibited whenever it imposes any strain. When possible young children should not be required to climb stairs in the school building. This rule applies with even greater force to the school child who is delicate or has a cardiac defect.

The ideal school is the open-air school. To what degree the open-air-school method may promote well-being may readily be learned from the work of Rollier and his associates (p. 26).

The **private tutor** is of value in the exceptional case only when special attention is demanded because of the existence of peculiarities or defects in development which handicap the child with his fellows, or when time lost because of illness (from which recovery has been as complete as possible) must be made up. If a child is to become a great musician or attempt the prodigious in any chosen sphere the demands of childhood must be recognized as even more insistent than in ordinary cases, and in some way these demands must be satisfied even at the sacrifice of the technical and the artistic.

**The Summer Camp.**—This institution is a development of the past two decades. As a means of promoting out-door life and helpful association between growing boys and as a preparation for the boarding school or college of later years, the summer camp is of great value. On the other hand, one cannot deny that the influence of a bad, improperly supervised camp may be far reaching in ill effects.

Certain rules applicable to all camps of any size may be mentioned:

The general sanitary regulations of a good army camp must be rigidly adhered to. The water and milk supply must be beyond suspicion. Provision for isolation and care of the sick in separate quarters should be made. Sleeping tents should be provided with wooden floors. A resident physician or one in the immediate neighborhood should make daily

rounds with a view to caring for affections even as minor as bad sunburn. Bathing, particularly, should be supervised. Regular hours for sleep at night and an afternoon rest hour should be enforced.

The wisdom of sending a boy or girl to a summer camp before the age of ten or twelve years is questionable. Our advice to parents should be that they themselves inspect the camp in person before making an enrolment.

**Physical Training.**—Voluntary exercise is a part of the normal life of every child. Play in the open air, with all that play signifies—running, jumping, bicycle riding, ball playing, tennis, swimming, and skating—make for a good physique without the need of gymnasia and classes for postural correction. Aside from the normal play activities and the simple setting-up exercises employed in the modern school, special physical training is not ordinarily required. If indoor exercise must be substituted, the specialized forms of children's dancing probably offer the most benefit in developing the body symmetrically. Dancing for girls and appropriate modifications of military drill for boys fulfil the demands for beneficial exercise without the sacrifice of fun.

The boy and girl scout activities probably meet the developmental requirements of late childhood as well if not better than any other single agency.

## DISEASE PREVENTION

**General Safeguards.** The knowledge that because the more common infectious diseases are seldom escaped throughout childhood, and that certain of these diseases frequently assume a severe form in attacking the adult who has no immunity from a previous attack, leads many people even in this enlightened day to advocate the exposure of children promiscuously to whooping-cough, measles, and various other diseases. "Unjustifiable" is too mild a term to characterize such a course. It is no less than criminal. Statistics indicate clearly the generally increased susceptibility and the higher mortality during the first few years of life. Statistics likewise show the greatly decreased incidence of such diseases in adult life even among those who have never previously been attacked. Without this knowledge science and instinct together should still dictate the fullest measure of postponement of exposure, if not extreme protection against exposure, in the safeguarding of the young.

The young child has no place in a crowd. The crowded theater, the crowded department store, the crowded railway train, and even the crowded elevator afford a risk at all times of infection by contact. The mother who appreciates this fact and acts accordingly, who supervises her child's playmates, and constitutes herself a beneficent detective upon their mention of sore throat, or their paroxysmal coughs will, without giving offence or instilling panic, go far in the safeguarding of her own fold. She must still be on guard against those of her own household. (See pp. 29-30.)

**Specific Measures.**—That means for the eradication of smallpox, diphtheria, and typhoid must be made the subject of publicity campaigns is a commentary on the bigotry and laziness of too many people. As the list of diseases for which preventive specific therapy becomes longer

it is to be hoped that these obstacles encountered in the past will no longer block the road.

There is no valid argument against the immunization of a well baby against smallpox in the first year of life or his protection against diphtheria at the end of the first year. There is the best of reasons for the application of the Schick test to older children and the best of reasons for typhoid vaccination for children who bathe in public pools or travel with their parents in unsanitary countries.

The details of application of the different methods will be considered under discussion of the respective diseases.

### DIET FROM THE FIRST TO THE ELEVENTH YEAR

At the completion of the twelfth month the average well-regulated baby should be weaned and given other nourishment. If bottle fed, he should receive more than the milk and cereals with which most children are fed. The food suitable for the second year of life and the method of its preparation and administration are subjects concerning which the masses are most profoundly ignorant. A few children at this period of life are underfed, but the great majority are overfed and carelessly given, at improper intervals, unsuitable food, indifferently prepared. Summer diarrhea finds its greatest number of victims among those children over twelve months of age who have been carelessly fed.

**The Second Summer.**—The dreaded "second summer" robs many homes because of ignorant or careless parents. The second summer, approached properly, is hardly more dangerous than any other summer during the early years of a child's life. It is almost a universal custom, when the child is weaned or given something other than a milk diet, to allow him "tastes" from the table. Very often these tastes comprise the entire dietary of the adult. Milk is often the only suitable article of diet that is given. Eventually not only is the other food selected unsuitable, but it is given irregularly, and supplemented by crackers kept on hand for use between meals. During the hot months the gastrointestinal tract is least able to bear such abuse and the child becomes ill.

**Feeding After the First Year.**—Usually when the twelfth month is completed we give the mother a diet schedule, with instructions to begin gradually with the articles allowed, in order to test the child's ability to digest them. Every new article of food should be carefully prepared and given at first in very small quantities. All meals are to be given regularly, with nothing between meals. With many children this expansion of the diet list is attended with considerable difficulty. They are thoroughly satisfied with milk, and refuse all other forms of nourishment. In such cases time and patience are necessary at the feeding time. The more solid articles of diet should be given first and the milk kept in the background.

Among the underfed seen at this period of life are those who have been nursed too long and those who have been kept too long upon an exclusive milk diet. A great majority of the cases of malnutrition of the second year are seen in the exclusively milk fed. These children are pale, soft, flabby, and badly nourished.

The following is a diet schedule which has proved of value. The mother is instructed to select, from the foods allowed, a suitable meal:

*From the Twelfth to the Fifteenth Month: Four Meals Daily*

7 A. M.: Two or 3 tablespoonfuls of cornmeal, oatmeal, wheatena, hominy, rice (all cooked four hours the day before in water) served with butter or milk and a little sugar. Eight ounces milk from glass or bottle. Bread stuffs.<sup>1</sup>

9 A. M.: Juice of one-half orange or 3 ounces prune juice.

11 A. M.: One tablespoonful of either scraped steak, minced chicken or minced chop, or soft-boiled egg mixed with bread crumbs. Baked or mashed potato (medium size). Glass or bottle of milk. Bread stuffs. Sleep after this meal.

2.30 P. M.: Eight ounces chicken or mutton broth with bread or rice in the broth, or 8 ounces milk. One tablespoonful stewed carrots, squash or spinach when broth is given. Desserts: Custard, cornstarch, junket. Bread stuffs.

6 P. M.: Two or 3 tablespoonfuls farina or cream of wheat (cooked two hours in water), or one of above cereals served as directed. Eight ounces milk from glass or bottle. Bread stuffs.

*From the Fifteenth to the Eighteenth Month: Four Meals Daily*

7.30 A. M.: Two or 3 tablespoonfuls cornmeal, oatmeal, wheatena, hominy, rice (all cooked four hours the day before in water), served with butter or milk, with or without sugar. Glass of milk. Bread stuffs.<sup>2</sup>

9 A. M.: Juice of one orange or 3 ounces prune juice.

11 A. M.: One tablespoonful scraped steak, minced chicken, minced chop, or a soft-boiled egg mixed with bread crumbs. Baked or mashed potato. One tablespoonful spinach, asparagus, string beans, peas, squash, stewed carrots, or stewed celery. Desserts: Stewed apples, stewed prunes, baked apple. No milk at this meal. Bread stuffs. Sleep after this meal.

2.30 P. M.: Eight ounces of chicken or mutton broth with bread or rice in it or 8 ounces milk. Small cup of custard, cornstarch, or junket. Bread stuffs.

6 P. M.: Two or 3 tablespoonfuls farina or cream of wheat (cooked two hours in water) or one of above cereals served as directed. Glass of milk.

*From the Eighteenth Month to the Third Year: Three Meals Daily*

7.30 A. M.: Two or 3 tablespoonfuls cornmeal, oatmeal, wheatena, hominy, or rice (all cooked four hours the day before in water), served with butter or milk, with or without sugar. Glass of milk. Bread stuffs.

9 A. M.: Juice of one orange or 3 ounces prune juice.

12.30 P. M.: One or 2 tablespoonfuls scraped steak, chop or minced chicken, or soft-boiled egg. Baked or mashed potato. One or two tablespoonfuls spinach, asparagus, string beans, peas, squash, white turnip, stewed carrots, stewed celery, or stewed onions. Desserts: Stewed apple, stewed prunes, baked apple, rice-, bread-, or tapioca-pudding. Gelatin pudding with lemon, vanilla, or orange flavor. No milk at this meal. Bread stuffs.

Rest one and one-half hours after this meal.

4 P. M.: Drink of milk and piece of toast or plain cracker.

6 P. M.: Two tablespoonfuls farina or cream of wheat (cooked two hours in water) or one of above cereals served as directed. Drink of milk or 8 ounces chicken or mutton broth. Spaghetti. Desserts: Custard, cornstarch, or junket. Cream cheese or honey on bread or crackers. Bread stuffs.

*From the Third to the Fifth Year: Three Meals Daily*

7.30 A. M.: Three to 4 tablespoonfuls cornmeal, oatmeal, wheatena, hominy, or rice (all cooked four hours the day before in water), served with butter or milk, with or without sugar. One slice of bacon or soft-boiled or poached egg. Cereal may be given with either bacon or egg, or egg may be given alone with milk and slice of bread and butter. Glass of milk. Bread stuffs.

12.30 P. M.: Steak, chop, minced chicken, baked or boiled halibut or codfish. Baked or mashed potato. Two tablespoonfuls spinach, asparagus, string beans, peas,

<sup>1</sup> Bread stuffs: Wheatworth biscuit, zwieback or Holland rusk, toast.

<sup>2</sup> Bread stuffs: Wheatworth biscuit, zwieback or Holland rusk, dried bread, plain white or whole wheat bread, toast.

squash, white turnip, stewed carrots, stewed onions, mashed cauliflower. Desserts: Stewed apple, stewed prunes, baked apple, rice-, bread-, or tapioca-pudding. Gelatin pudding with orange, lemon, or vanilla flavor. Stewed or raw peaches and cherries. All stewed fruits in season except strawberries. Bread stuffs.

Rest one and one-half hours after this meal.

4 P. M.: Scraped apple, pear, or grapes.

6 P. M.: Three or 4 tablespoonfuls farina or cream of wheat (cooked two hours in water) or one of above cereals, served as directed. Instead of cereal, spaghetti may be given. Glass of milk, or 4 ounces milk, 4 ounces water and 1 teaspoonful Phillip's cocoa, with sugar, or 8 ounces chicken or mutton broth. Custard, cornstarch, junket. Cream cheese or honey on bread or crackers. (Either milk, cocoa, or soup may be given at night for variety.) Bread stuffs.

Raw fruit may be enjoyed by most children during the midafternoon at this age. Apple, pear, grapes, or half medium-sized banana may be given.

*From the Fifth to the Seventh Year: Three Meals Daily*

7.30 A. M.: Three to 4 tablespoonfuls cornmeal, oatmeal, wheatena, hominy, or rice (all cooked four hours the day before in water), served with butter or milk, either with or without sugar. Bacon, soft-boiled, scrambled or poached egg or minced chicken. Glass of milk. Bread stuffs. (The child will do best at this age if he is given more than a cereal and milk breakfast.)

12.30 P. M.: Steak, chop, roast beef, roast lamb, poultry, baked or boiled halibut or codfish. Baked or mashed potato. Two tablespoonfuls spinach, asparagus, string beans, peas, squash, white turnip, stewed carrots, stewed celery, stewed onions, mashed cauliflower. Desserts: Stewed apple, stewed prunes, baked apple, rice-, bread-, or tapioca-pudding. Gelatin pudding with lemon, orange, or vanilla flavor. Raw and stewed peaches and cherries. All stewed berries in season except strawberries. Bread stuffs.

Rest one and one-half hours after this meal.

4 P. M.: Raw apple, pear, grapes, or banana.

6 P. M.: Three tablespoonfuls farina or cream of wheat (cooked two hours in water) or one of above cereals served as directed. Glass of milk or 4 ounces of milk, 4 ounces of water and 1 teaspoonful of Phillip's cocoa, or 8 ounces of chicken or mutton broth. When broth is given stewed fruit is to be given as dessert. Instead of cereal spaghetti may be given. Desserts: Custard, cornstarch, junket. Cream cheese or honey on bread or crackers. Bread stuffs.

*From the Seventh to the Eleventh Year: Three Meals Daily*

7.30 A. M.: Cornmeal, oatmeal, wheatena, hominy, rice (all cooked four hours the day before in water), served with butter or milk, either with or without sugar. Occasionally a dried cereal may be given—shredded wheat, cornflakes, puffed rice or puffed wheat. Bacon, soft-boiled, scrambled, or poached egg, minced chicken or broiled fish. Glass of milk. Bread stuffs.

12.30 P. M.: Steak, chop, roast beef, roast lamb, poultry, baked or boiled halibut or codfish. Baked or mashed potato. Spinach, asparagus, string beans, peas, squash, white turnip, stewed carrots, stewed celery, stewed onions, mashed cauliflower. Raw celery and lettuce. No milk at this meal. Desserts: Stewed apple, stewed prunes, baked apple, rice, bread, or tapioca pudding. Gelatin pudding with orange, lemon, or vanilla flavor. Raw and stewed peaches and cherries. All stewed berries in season except strawberries. Bread stuffs.

6 P. M.: Farina or cream of wheat (cooked two hours in water) or one of above cereals served as directed. Glass of milk or cocoa. Chicken or mutton broth or dried pea or bean soup. When soup is given, stewed fruit is to be given as dessert. Instead of cereal spaghetti or baked potato or 2 or 3 tablespoonfuls of green vegetables may be given. Desserts: Custard, cornstarch, junket. Cream cheese or honey on bread or crackers. Bread stuffs.

Many children require considerable variety in the preparation of the cereals suggested. The flavoring may be changed by the use of maple syrup and butter.

It will be noticed that dried boxed cereals are allowed. This is to secure variety for those who do not take kindly to the cooked products.

## MALNUTRITION IN CHILDHOOD

## ERRORS IN FEEDING

In the care of the bottle-fed the most frequent error is *overfeeding*, or the use of a stronger mixture than the child is able to digest. Particularly is this apt to be the case at the commencement of bottle feeding. The amount is usually too large and the intervals between the feedings are almost invariably too short. *Children of the same age cannot all be fed alike.* Artificially fed babies of equal health and vigor, but of considerably varied size and weight, will require food of approximately the same strength, and the same intervals between feedings; but the larger the child, the greater the quantity of food required. Thus, the quantity given at one feeding for a child weighing 13 pounds at the sixth month will not be sufficient for a child of the same age weighing 16 pounds.

Nervous overactive children and those subject to a good deal of attention will require a greater amount of nourishment than the less active children with quiet surroundings. In other words, the active child burns up more food than one less active in order to supply the requisite nervous energy.

Keeping the child on an exclusive milk diet until the twelfth month or later is a not infrequent error. As a rule, starch in some form may be added to the food at the seventh month, and should always be added as early as the ninth month. The giving of food other than well-cooked cereals and milk before the eighth month is a mistake made in many households, and a common error from the twelfth month to the third year is to allow the child's diet to consist largely of milk and insufficiently cooked cereals. Crackers and milk, bread and milk, cake, and fancy crackers often constitute the only articles of diet during this very important period of growth. The fact that a high protein food is as necessary for proper development now as at bottle age is overlooked. During early infancy milk is invaluable, but it is not sufficient for the demands of older childhood. Milk, eggs, meat, and cereals, such as oatmeal, rich in protein, are absolutely necessary to normal growth.

Irregularity in feeding is another frequent error. The child should have his meals "on the minute," at the same time every day. The lack of observance of this rule will surely result in loss of appetite and indigestion. Indiscriminate eating between meals of bread and butter, pastry, or confectionery, if persistently practised, will surely be followed by indigestion and malnutrition.

Forcing or coaxing a child to eat is a practice always to be avoided. If suitable food is given at definite well-ordered intervals, a normal child will be hungry at those intervals. If he does not eat, something is wrong, and it is our duty to discover the cause of his loss of appetite.

## HABITUAL LOSS OF APPETITE

The child, like the adult, not only requires sufficient nourishment to sustain life, but, in addition to this, an extra amount to supply the demands of growth. Proportionate to their size, all growing animals require more food than do those that have reached maturity. The young child

is naturally such a very hungry animal that ample feeding is absolutely essential. Therefore, when there is habitual loss of appetite so that the child's entire life may be unfavorably influenced, we must realize that the condition is abnormal and strive to discover the cause and apply the remedy.

Physicians are often consulted by parents whose children are suffering temporarily or persistently from loss of appetite—a condition usually associated with secondary anemia and defective growth. The child apparently is not ill; he may be active and playful, but he tires easily. The sleep ordinarily is sound and refreshing, but the child must be coaxed to eat. Often he will take food only when his attention is diverted by a story or a toy. He usually eats for the entire family, taking a mouthful each for father and mother, and for the cook! Three or four times a day, depending upon the number of meals, this coaxing, entertaining process has to be gone through.

Occasionally children with habitually poor appetites for food in general will have a history of excessive milk drinking. From 3 to 5 glasses of milk may be taken daily and all other food refused. When milk forms the principal or only article of nourishment after the eighteenth month, children will invariably show evidences of malnutrition. They are apt to be pale and sallow, with flabby muscles.

The most frequent cause of loss or lack of appetite is too frequent feeding. It is not at all uncommon to see children from two to four years of age who are being fed six or seven times in twenty-four hours, the argument of the parents being that: "The child takes so little food, he ought to take it oftener." With increasing age, more and stronger food is required at less frequent intervals. In other cases children may not get their regular feedings at such frequent intervals, but are generously supplied between meals with candy, cake, crackers, and fruits. Unsuitable food may be the cause of a habitually poor appetite.

Children of tender age who are regularly fed from the adult table with heavy adult food, often improperly cooked, soon suffer from loss of appetite.

Children who are poor eaters usually have the associated ailment—constipation.

Too close confinement indoors is not infrequently associated with, if not a direct cause of, lack of appetite. Children who are kept uninterruptedly in the house for weeks at a time invariably have poor appetites.

Children with stomachs of slow emptying capacity (Fig. 37) are almost invariably those in whom the appetite is habitually poor. An x-ray study of the stomachs of a considerable number of these cases shows residue after a bismuth meal from five to twelve hours (p. 222).

*Illustrative Case.*—A girl five years of age was brought because of habitually poor appetite. Coaxing and forcing were always necessary. There was a moderate appetite for breakfast. The other meals had to be forced and vomiting at the table frequently resulted. An x-ray study was made, and it was found that there was a food residue after ten hours. The retention was corroborated by the use of the stomach-tube after an ordinary meal.

**Treatment.** In order to emphasize a point in teaching, when treatment is under consideration, it has often been found useful to state, first,

what *not* to do. Do not give these children drugs as a means of inducing an appetite until all other means have failed. The only medication that should be permitted is some simple laxative. There must be one evacuation of the bowels daily. The aromatic fluidextract of cascara sagrada, from 1 to 2 drams, given daily at bedtime, or from 3 to 5 ounces of the citrate of magnesia, given before breakfast, ordinarily answers well.

*Fresh Air.*—Every "runabout" child with poor appetite should spend at least five hours daily in the open air, regardless of the season of the year. During very inclement weather in winter indoor airing (see p. 838) is a most satisfactory substitute.

*Diet.*—An important step in the treatment is the regulation of the feeding hours. A child from twelve to fifteen months old should have four feedings daily (see Dietary, p. 135). Ordinarily, for "runabout" children from the fifteenth to the twenty-fourth month, four meals daily are necessary, but when there is loss of appetite, three meals at five-hour intervals often answer best. After the second year three meals are invariably the rule unless the child is weak or ill. All feedings should be given at a definite time each day, from which there should be no deviation. Nothing whatever except water should be allowed between meals in the retention cases. The next step, in case these regulations fail, is to place the child *temporarily* on a markedly reduced diet, no solid food, such as meat, eggs, bread stuffs, vegetables, or fruits, being allowed. Milk, gruels, and broths should comprise the nourishment. When the desire for food returns the regular feeding schedule is to be resumed. The mother must be given the directions both orally and in writing.

If the case is one of milk habit, then the milk must be entirely cut off, and broth, thin gruel, dry bread, or zwieback substituted. The mother is instructed to return with the child in two days. In the great majority of instances the report after forty-eight hours is that the child is ravenously hungry. When such is the case freer feeding is allowed, but under the same strict observance of feeding intervals, with absolutely no feeding between meals. It is extremely rare to meet a case of habitual loss of appetite which will not respond to this simple method. In a large number of cases of failing appetite we have succeeded in restoring the desire for food by removing milk largely from the diet, having it skimmed and given in small amounts, morning and evening, and in reducing the sugar intake to a minimum. Many children get more milk than is good for them, and practically all children get more sugar than they can utilize with benefit.

*Feeding in the Retention Cases.*—When food residue is found to be habitually in the stomach the interval between the feedings must be prolonged. The breakfast is to be given at 7 A. M., dinner at 1, and supper at 6 P. M. Immediately after feeding the child should rest in a recumbent position for one hour, preferably on the right side. But little fluid should be given with the meal. Our schedule in these cases is roughly as follows: Breakfast at 7 A. M., with 6 ounces of milk; 10.30 A. M. a drink of water; 12.30 P. M. usual meal without water, soup, or milk; 4 P. M. milk or water; 6 P. M. usual supper with milk. To bed immediately, or supper to be given in bed.

*Change of Climate.*—Occasionally a child fails to show the least evidence of disease and yet will not respond to proper dietetic and hygienic

measures. For such a case a change from the city to the country, or from the inland country to the seashore, has been followed by a decided improvement. When such changes are impossible, or when proper dietetic regulations are impracticable, as with dispensary patients, medication may be of service.

*Tonics.*—One of the best medicinal means of improving the appetite in cases in which there is no delay in emptying and no hyperacidity is a solution of citrate of iron and quinin in sherry wine, 1 to 2 grains of citrate of iron and quinin being dissolved in  $\frac{1}{2}$  dram of sherry wine and given, well diluted, before meals. This dosage will answer for children over eighteen months of age. For younger children, 1 grain of the citrate of iron and quinin in  $\frac{1}{2}$  dram of sherry wine, well diluted, may be given. If this is not successful, 1 minim of dilute hydrochloric acid,  $\frac{1}{2}$  minim of the tincture of nux vomica, and 2 teaspoonfuls of water may be given at two-hour intervals to children over fifteen months and under two years of age. After the second year 2 minims of the dilute hydrochloric acid and 1 minim of nux vomica, in 3 teaspoonfuls of water, may be given at two-hour intervals.

There remain also to be considered under this head not a few children who habitually suffer from poor appetite and are below the average in every respect.

#### THE PHYSICALLY SUBNORMAL CHILD

In the treatment of the diseases of children the general practitioner as well as the pediatric specialist is frequently consulted regarding children who are deficient in physical development. They lack endurance and possess poor resisting powers. They are usually underheight, always underweight, and, in short, have so many subnormal physical characteristics in common that they constitute a class by themselves.

*Normal Development.*—The average child, at the various periods of early life, conforms with a certain degree of regularity to the mental and physical development which by long association we have come to regard as normal. Thus a standard may be said to have been established, and it is up to this standard that we expect the growing child to measure. This is what we look upon as the average of physical and mental development. A few children exceed these requirements and are stronger and larger at the sixth month than the average child at the ninth month. Again, older children at the fourth or fifth year may be in every way equal to their normal playmates a year or two older.

*Abnormal Development.*—On the other hand, there are children who are born with reduced vitality, or who, through faulty management, usually in relation to feeding, have a reduced vitality. Semi-invalid adults almost invariably beget semi-invalid children. If the parents are of average health and of good habits and the debilitated condition of the child is due to faulty management and nutritional errors, the result of proper dietetic and hygienic management is usually prompt and satisfactory. With the persistently subnormal, the offspring of physically enfeebled parents, the results are less satisfactory.

*Treatment.*—By proper regulation of the habits of such a child, as regards all the details of his daily life, a far better adult is produced than if no such effort has been made. In other words, a diet and general régime

of life best adapted to the individual in question will invariably improve the physical condition of that individual. This applies to the strong as well as to the subnormal, to the growing young of the lower animals as well as to the offspring of man. It is the poorly developed, delicate child that we are particularly to consider—the undersized, frail, small-boned child, whose appetite is persistently poor or capricious, who sleeps poorly, tires easily, is usually constipated, who is subject to catarrhal conditions of the respiratory tract, and whose powers of resistance generally are diminished.

On assuming the management of one of these children it is absolutely necessary to make a thorough examination, followed in some instances by a few weeks' observation, in order to become acquainted with the case in its individual aspects, to learn idiosyncrasies, and to eliminate the factor of actual disease as a caustive agent. When we demonstrate to our satisfaction that the child is free from such diseases as tuberculosis, syphilis, and malaria; when we have eliminated by properly directed treatment all causes, such as adenoids, phimosis, vaginitis, or parasitic and irritant skin lesions, which may have had a deterrent influence upon growth; and when we have satisfied ourselves as to the actual condition of our patient, we are in a position to lay down definite rules of management.

Inasmuch as growth and development depend, above all things, upon a properly adapted food-supply, it must be our first step to provide such nutriment as will be most conducive to growth. As growth takes place in all parts of the body through cellular activity, the nutritive elements which promote cell nutrition and proliferation must be important constituents of the diet, and among these the proteins are of prime importance; hence in the management of these children a point to be remembered in the adaptation of the food is the necessity of feeding as rich a protein as the child can assimilate. The younger the child, the greater the necessity for growth.

*Regular Weighings Necessary.*—An infant should be weighed at regular intervals, and if under one year of age should not be considered as doing even passably well if not gaining at least 4 ounces weekly. When a baby remains stationary in weight the development is invariably abnormal. When the weight is stationary or when only a slight gain of 1 or 2 ounces weekly is made, we always find after a few weeks that there is malnutrition in spite of the apparent gain, as will be evidenced by the symptoms of beginning rickets—anemia, the characteristic bone changes, flabby muscles, and a tendency to disease of the mucous membranes. Subnormal infants should be weighed daily at first; then, as improvement takes place, at intervals of two or more days, but never less frequently than once a week during the first year, no matter how vigorous they may become. The weighing keeps us directly in touch with the child's condition, but since the increase may be in fat alone, an occasional examination of the child stripped is necessary to tell us whether there is substantial growth in bone and muscle.

*Feeding Infants.*—When it is demonstrated that a child will not thrive on the breast of the mother, another breast should be substituted, or an adapted high protein cow's milk should supplement or replace the breast

milk. If the child is bottle fed and it is demonstrated that proper growth and development are impossible on cow's milk on account of protein incapacity, then a wet-nurse should be secured.

When, after the first year, more liberal feeding is allowed, the necessity for high protein in the food selected is as urgent as before. This applies to those children who show evidences of late malnutrition, as well as to those whom we have under our care from early infancy.

An important element in the diet up to the third year is milk. A child from the first to the third year ought to receive 1 quart of milk daily. Unfortunately, many debilitated children have a very poor capacity for fat assimilation. When given full milk in as small an amount as 1 pint daily, they often develop foul breath, coated tongue, and loss of appetite, or they suffer from frequent attacks of acute indigestion. The milk is necessary, not because of the fat, which can easily be dispensed with, but because of the high percentage of protein which it contains—from 3 to 4 per cent. When this fat incapacity exists, the milk is said to "disagree," although skimmed milk will be taken without inconvenience. Enough sugar may be added to bring the percentage up to seven, in order that the extra sugar may replace the fat for fuel. Skimmed milk with sugar added furnishes a food of no mean order. Too much milk, however, must not be given. When more than 1 quart daily is taken, the desire for more substantial nourishment, such as eggs, meat, and cereals, is removed.

*Diet After the First Year.*—At the completion of the first year, keeping in mind the high protein we may give scraped beef, at first 1 teaspoonful once a day, in addition to the cereal and milk. If the beef is well borne, and it usually is, a teaspoonful may be given twice a day, and later three times a day, immediately before the bottle feeding. Eggs should be brought into use from the twelfth to the fifteenth month. At first one-half an egg, boiled two minutes, is given mixed with bread crumbs. If well borne, a whole egg may be allowed. The cereals used should be those richest in vegetable protein, such as oatmeal, containing 16 per cent. of protein, dried peas, with 20 per cent. of protein, and dried beans, containing 24 per cent. of protein. The peas, beans, and lentils should be given in the form of a purée.

If the child during the second year has an indifferent appetite, the quantity of milk should be reduced, never more than 1 pint of skimmed milk being permitted daily for the first week or two. Many subnormal children who apply for treatment after the first year of age have been subjected to as grave errors in diet as are seen among the bottle fed. Starch and milk frequently furnish the only nutrition up to the fourth or fifth year, the starch used being generally in the form of bread, crackers, and ill-cooked cereals. In one case 4 quarts of milk were taken daily by a boy of seven years.

In dealing with this class of children—the delicate, undersized, slow-growing class—it is our aim to give as liberal nitrogenous nourishment as is compatible with the digestive capacity of the patient. If, however, the child has had rheumatism, or if there is a tendency to lithiasis, the use of a large amount of meat is contraindicated. For such children the high protein cereals are particularly valuable.

In general, from early life the diet of the delicate child should consist of milk, suitably adapted, with highly nitrogenous cereals added when permissible. Many subnormal children of the "runabout" age who cannot digest milk containing 4 per cent. of fat will easily digest butter-fat spread on bread or potatoes. Used in this way butter constitutes a protein sparer. Oatmeal-water or oatmeal jelly, mixed with the milk, should be ordered at the seventh month. When age allows, the addition of rare meat, poultry, eggs, and purées of dried peas, beans, and lentils should be made. Boxed, "ready to serve" cereals are never to be given; raw cereals are essential which are cooked three hours. While a high protein diet is desirable, other foods are necessary. Green vegetables, animal fats, the ordinary cereals, cooked and raw fruits, are required to furnish the necessary acids and salts, as well as the necessary variety. In short, the ideal diet for a subnormal child is that combination of foods which, while imposing the least burden upon the digestive organs, supplies the body with material sufficient for its needs. (See Dietary, p. 135.)

*Baths.*—On account of the fear that a delicate child may take cold, the bath is often omitted. All children, both the well and the subnormal, after the second week should be tubbed daily; the delicate particularly require bathing. The salt bath (p. 843) is usually advised. The best time for giving the bath is at bedtime, and in order to avoid all chance of exposure the temperature of the room should be elevated to 80° F. The temperature of the water may vary. It should never be above 95° F. except for very delicate young children in whom there is a tendency to a subnormal temperature. Even in these cases the temperature of the bath should never be higher than the temperature of the body. For the frail and the very young the bath should not be continued over five minutes. In bathing children of eighteen months or over, if the physical conditions allow, a distinct advantage will be gained by a reduction of the temperature of the bath while the child is in the water. An immersion in water at 90° F., followed by a gradual reduction during the space of five or six minutes to 70° F., should, upon brisk rubbing, be followed by quick reaction. For children after the third year a graduated cold spinal douche has served well. (See The Cold Douche, p. 842.) If the reaction is not good, if the extremities are slow in becoming warm, the reduction in the temperature should be less or none at all. With the very poorly nourished a reduction below 80° F. should not be attempted. Following the drying process, primarily for the benefit of the massage, goose oil, unsalted lard, or olive oil should be rubbed into the skin over the entire body for five to ten minutes. The bath and massage inunction, besides favorably influencing nutrition, are very effective in inducing sleep.

*Fresh Air.*—Subnormal children are usually deprived of a proper amount of fresh air for the same reason that they are insufficiently bathed—the fear of making them ill. All children need an abundance of fresh air both in illness and in health. To the delicate fresh air is even more essential than to the robust. As many hours daily as practicable should be spent out of doors. The time thus spent depends upon the season of the year and the residence of the child, whether in the city or the country. In the city, during the colder months with pleasant weather, the

child should spend at least five hours daily in the open air, dividing the day into two outing periods—from 9 to 11.30 in the morning and from 2 to 4.30 in the afternoon. On very cold days (20° F. or below), on stormy days, and on days with very high winds the child should be given his airing indoors. He is dressed as for out of doors, placed in his carriage, and left in a room, the windows on one side of which are open. Not infrequently during February and March subnormal children will be prevented from going out of doors for several consecutive days. If some means for a daily systematic indoor airing is not provided, these children will often go backward, no matter how excellent the other management. The first symptoms are loss of appetite and the ability to assimilate food. In private work among athreptics, the child has been placed in the baby carriage or in a basket and allowed to rest before an open window for ten or twelve hours of every twenty-four, with a hot-water bottle at his feet. Here he has been fed, being removed only temporarily to warmer quarters for a change of napkins.

*Sleep.*—The subnormal child requires no more sleep than does the strong, and the rules governing this function at the various periods of life are the same both for the strong and for the weak. (See Sleep, p. 28.) The sleeping-room should always communicate with the open air by a window, either directly or through an adjoining room. A satisfactory means of ventilation is the window-board (p. 26). The child should occupy the room alone, if possible, sharing it neither with an adult nor another child. This ruling applies to all ages, but is particularly necessary after the second year.

*The Nursery.*—The temperature of the nursery, day or night, should never be above 70° F. during the colder months. Very young infants, and those who are with difficulty kept covered, should not sleep in air below 65° F.

Subnormal children of the "runabout" age are very susceptible to colds. In the management of such children it is necessary to use every precaution against exposure. The most frequent way of exposing a child to cold is by allowing him to sit on the floor. To keep the child of ten months to three years of age off the floor during the winter months, and thereby to eliminate this means of exposure, is very difficult. In fact, with active children learning to walk, or who have just learned to walk, it is practically impossible under the usual conditions. During the colder months there is always a current of cold air near the floor, and allowing the child to creep in winter, even if the floor is protected by rugs and carpets, is one of the surest ways of permitting him to take cold. If he is allowed to walk on the floor, he is very sure soon to sit down. If he is not allowed to creep and walk about at will, he will not get the proper exercise and will show faulty development. For such cases the exercise pen is of immense service. (See p. 839.) After being dressed, washed, and fed, the child is placed in the pen, on a rug if desired. Toys are given him and the door is closed. He can now roam about at will, stand up, sit down, creep or walk without the slightest danger from drafts.

*Influence of Climate.*—Much has been written regarding the influence of climate in the type of case we are considering. According to our observation, this matter does not deserve the attention it has received.

The city child in a well-to-do family is, as a rule, better off for eight months of the year in his own home with its usual conveniences. The benefits attributed to change in climate are usually the result of a change not of climate, but to more fresh air, which is afforded by the larger rooms of the hotel, with its loosely constructed doors and windows; and the fact that, since the parent is desirous that the child shall receive the full benefit of the change, he is kept in the open air for a much longer time than when at home. The air at such a place is more expensive, and consequently more appreciated than the air at home. With sufficient heat and proper ventilation we may make our own climate. It is not to be denied, however, that a change of residence for a few weeks, during March and April, from New York to Lakewood or Atlantic City, is sometimes of advantage.

From the first of June to the first of October the child should not remain in any large city if removal is possible. The humidity and the heat which may prevail for protracted periods during this time render the city unsafe, particularly during July and August. The seashore for the entire summer is not to be advised. The children who have been sent inland to the country and to the mountains have, as a rule, returned in the autumn in much better physical condition than those who spend the summer by the sea.

*Clothing.*—Thin, poorly nourished children require more clothing than do those physically normal. A fairly good index as to whether a child is sufficiently clad is the condition of his lower extremities. The forearm and hand cannot be relied upon. The legs and feet of every child should always be warm to the touch.

As clothing, a mixture of silk and wool next to the skin is most desirable. Although less desirable, a mixture of wool and cotton may be used. The linen mesh, often useful for the vigorous "runabout," is not to be advised.

*Exercise* is to be encouraged, but should never be allowed to the point of fatigue. In large cities all subnormal "runabouts" from three to five years of age should be allowed to walk not more than six blocks in going to the playgrounds. If the distance is greater, the child should ride part of the way, play or walk for a time, and then be placed in the carriage or cart and ride home. Younger children, two or three years of age, should be wheeled both ways and taken out at the park for a run when the weather conditions permit.

*Midday Nap.*—Every day after the midday meal the child, regardless of age, whether two years or six, should be undressed and put to bed for two hours. He should be left alone in the room, and whether he sleeps or not he should remain in bed for the two hours.

*Entertainment.*—Entertaining play is necessary, but every kind of excitement, such as children's parties, emotional plays at the theater, and rough play with older children, should be avoided.

*Education.*—The delicate child under eight years of age should be taught only to the extent of strict obedience and good habits. In other respects he should be a little animal. There should be no teaching in the ordinary sense of the term, no mental stimulation, until the child is physically able to bear it. When school-work begins, which in this

class of children should never be before the eighth year, the studies should be made easy and the school hours short. Such children should never be forced and usually should attend only the morning session.

The delicate child should be carefully watched from the time he comes into our hands until he reaches the normal, or until the period of development is completed. While the management as outlined will not always be attended with brilliant results, it will not be in vain. Many lives will be saved, and as a result of their increased resistance stronger men and women will be added to the race.

Now and then one meets with a case among the well-to-do in which, because of prolonged faulty feeding or vicious heredity, the vital spark is so low that, fan it as we may, no impression upon it is made. As a rule, these stubborn patients are the offspring of alcoholism and debauchery. The patients are thin, anemic infants; they develop into thin, anemic children, and into thin, anemic adults. The subnormal and degenerate are found in all the walks of life, but they are especially numerous in dispensaries and in children's institutions.

Much of the work of the pediatricist is with the weakly of the so-called "better class." His success in the management of these children depends largely upon the home co-operation, and a promise of this should be obtained before taking the case. The parents must be taught that the development of the intellect, the character, and the body go hand in hand, and that a vigorous intellect is rarely found without a vigorous body. They must be convinced that the body is more than a machine. It has delicate organs to keep in repair and supply with energy. It has a nervous organization; it has sensibilities. The normal exercise of all these functions demands the normal nourishment of the body. In our experience family co-operation is at times difficult to obtain. The parents have begun well, but soon tired of the extra work required. It is difficult to make the untrained mind appreciate the necessity of continuous careful attention to details in management.

#### TARDY MALNUTRITION AND MALNUTRITION IN OLDER CHILDREN

Malnutrition, associated with tuberculosis and syphilis, is not a part of our subject.

In the sections on Malnutrition in Infants and Children it may be thought that there is repetition of what is said under the title of The Physically Subnormal Child. While the management necessarily is along the same lines, two distinct types of children are represented. The marasmic and malnutrition infant or young child may be but temporarily delicate. When he recovers he may develop into as normal a specimen of robust childhood as could be desired. The physically subnormal child as he has been described is inherently delicate, and our efforts are toward improving his condition, with the hope, perhaps, but with no great assurance, that he will some time become a robust adult.

Tardy malnutrition is usually seen in children of the school age, although it may appear any time after the third year. Such children are deficient in weight, in resistance to disease, and in capacity for work; they are pale, thin, tired children.

**Etiology.**—Cases of tardy malnutrition as well as those of marasmus and infantile malnutrition are seen in all the walks of life, among the wealthy, the so-called middle class, and among the poor. Strange as it may seem, these cases, regardless of the station of life, have two causes common to all, waste of energy and defective feeding. The scion of wealth who is overfed or badly fed—given food which is unsuitable and allowed the promiscuous use of sweets—may develop malnutrition just as effectively as the child of the tenement who subsists on fried meats, grocery milk, boxed breakfast foods, and poorly cooked vegetables.

Most important factors in these cases are overwork—excessive energy output in school, at work, or at play—and inadequate rest. The child is active from early morning until bedtime at 7 or 8 o'clock. This entails waste of vitality and the organism suffers. Every child until the seventh year should have an after-dinner rest, sleep if possible, for one to one and one-half hours. There should be twelve hours of uninterrupted sleep at night.

In all cases errors in the daily life of the patient will be most apparent.

There is a painful lack of knowledge among all classes as regards the nourishment required by a growing child. He is fed to satisfy his appetite, and when this is accomplished, the parents believe that their duty is done. How far they fall short of proper feeding is demonstrated daily in out-patient clinics and in private work.

**Treatment.**—The first step in the management of a case of tardy malnutrition is to make a study of the gastro-intestinal tract. A great many children develop errors in nutrition because of defective gastro-intestinal mechanics (p. 220), associated with ptosed stomach and faulty intestinal formation making for poor absorption and slow elimination.

We have repeatedly seen children from five to ten years of age, with marked malnutrition, gain from 3 to 4 pounds the first month under treatment which consisted simply in inaugurating the midday rest and in giving food that they had a right to demand, properly prepared at definite intervals, providing, of course, that structural abnormalities have been corrected, in case they were found to exist.

The school child suffering from malnutrition should be removed from school temporarily, and as much outdoor life as possible should be made available to him, regardless of his station in life. Everything of a strenuous nature should be avoided. He should be put to bed early and encouraged to sleep late. A midday rest for one who shows marked emaciation and diminished resistance is absolutely essential.

*Illustrative Cases.*—*Case 1.*—The following is quite a usual history of an advanced case of malnutrition in a girl, seven years of age, and the treatment is that which we usually employ: The mother brought the girl to the out-patient service at the New York Polyclinic because the child was pale, did not grow, and was always tired—too tired to go to school, of which she was very fond; too tired to play with other children, as had previously been her custom. Her weight was 41 pounds. No food was being taken except on compulsion. There was no evidence of congenital syphilis or tuberculosis. There was a secondary anemia. The child slept in a badly ventilated room; she drank tea and coffee. Cake, pastry, and sweets were her regular diet, and because she did not eat at mealtimes she was allowed to eat between meals whenever and whatever she pleased. The following mode of life and diet was prescribed: She was to sleep in the front room, known as a sitting room or parlor, with a window open at least 6 inches. She was given three meals a day with nothing whatever between meals. The diet consisted of red meat once a day, 2 or 3 soft-boiled eggs daily, 1 quart of good milk

daily if it agreed (and it did agree). She was to have only natural cereals, such as oatmeal, cracked wheat, and cornmeal—each of which was to be cooked three hours the day before it was to be given. Baked or boiled potatoes and one green vegetable were to form a part of the dinner at midday. Stewed and raw fruits and plain puddings with home-made bread and plenty of butter completed the dietary. She was put to bed at 7 o'clock and arose at 7 the following morning. An after-dinner rest in a darkened room for an hour was insisted upon. Before retiring she was given a brine bath (p. 843), followed by brisk drying with a rough towel, after which her entire body was rubbed for ten minutes with olive oil. In one month a radical change had taken place. She had gained 4 pounds in weight. Her color was good. She complained no more of languor or fatigue. She was eager for school. The improvement continued, and in ten weeks she made a perfect recovery.

In not every case will results be so prompt and satisfactory. In some a longer time will be required before pronounced results are to be seen. Nevertheless, every child suffering from malnutrition of this type cannot help being benefited more or less by such a régime.

*Case 2.*—A most pronounced case of this type was that of a boy, eight years of age, who presented a most dilapidated picture. He was tall for his age, very thin, pale, habitually tired, and had a well-developed habit-spasm. He was restless, active, and played hard when he was not too tired to play. His weight was 59½ pounds.

The living régime prescribed was as follows: He breakfasted at 7.30 A. M. He was to remain in bed until 10 o'clock in the morning, then be up and about at play as he wished. Dinner at 12.30 was followed by a rest of one and one-half hours. Play was permitted without particular restraint until supper at 6.30. Bedtime was 7.30 P. M. He improved rapidly and in one month was permitted to arise with the family. From October 12th to May 27th he gained in weight 19½ pounds.

We have treated a great many of these cases of malnutrition in older children in the same manner by limiting the energy output, and right feeding. A gain of from 2 to 6 pounds a month for the first month or two is the usual result of the treatment. At the same time there is a radical change in the child's mental attitude and general appearance.

*Tonics.*—The tincture of nux vomica, 4 drops in water before meals, is sometimes given to children whose appetite is defective. One grain of the citrate of iron and quinin in 1 dram of equal parts of sherry wine and water may be substituted. If there is secondary anemia and defective nerve resistance, the following prescription may be given, interrupted by five days free from medication.

For a child five to ten years of age:

R.	Liq. potassii arsenitis.....	℥℥iv
	Liq. ferri albuminati.....	℥iv
	Syr. hypophosphitum (caleis et sodæ).....	℥iij
	Aquæ.....	q. s. ad, ℥vj

M. ft. Sig.—One teaspoonful after meals in water.

During the five days without the medication cod-liver oil may be given.

*Laxatives.*—If constipation is present, olive oil may be given internally, 2 or 3 drams after meals. If the oil is not well taken, or if it disagrees in any way, its use should be discontinued. Liquid petrolatum (aromatic), in ½- to 1-ounce dosage at bedtime, answers well. The dosage may be gradually reduced and later discontinued.

### ESSENTIALS IN THE CARE OF ACUTE ILLNESS

A well child, regardless of the position he may occupy in the social scale, subscribes to a certain living régime, which should be so fashioned as to supply the requirements of nutrition and healthy growth, which means normal development. Thus, he is fed, clothed, and has the benefit of fresh air, exercise, and bathing. When he becomes ill his position tem-

porarily is changed, and in order for us to act to his best interest radical changes must be instituted in order to meet this changed condition as regards appetite, the digestive capacity, and rest. The great majority of the serious illnesses in children are acute in character. Vitality and resistance determine in no small degree the issue of the disease. Every child begins the illness with a definite number of strength units. We must so act as to conserve every strength unit.

Our first duty, then, toward the sick child is to place him in the most favorable position to withstand the ordeal through which he must pass. Regardless of the nature of the disease, certain requirements must be fulfilled that apply to all severe illnesses, the general management of which in children is very similar.

**Patient to Be Kept in Bed.**—The patient is to be kept in bed, not held on the lap. The handling of the child, the passing from one person to another, the attempt at entertaining, cause active excitement and waste energy when quiet is necessary.

**Quiet Attendants.**—Attendants who are quiet and agreeable to the child should care for him. In serious disease states—pneumonia, endocarditis, and the like—but one person, and that the attendant, should be allowed in the room at one time.

**Clothing.**—The clothing should be the usual night clothing to which the patient has been accustomed in health. There is no illness that requires extra clothing for the body when the customary room temperature (66° to 68° F.) is maintained. Heavy shirts and oiled silk or cotton-wool jackets are never to be employed, regardless of the nature of the illness.

In summer the lightest clothing should be used; for younger children a thin linen slip with the addition of a napkin is all that is required.

**Sponging.**—The body surface is to be sponged once or twice a day for cleansing purposes, regardless of the nature of the illness. During the hot days of summer the sponging may be repeated several times with advantage. There is no disease of childhood in which the application of water to the skin is a dangerous procedure. On the contrary, it is quite necessary that the skin be so treated that it function actively.

**Room Temperature.**—In winter the thermometer should never go above 70° F. Hot, ill-ventilated rooms depress the vital powers. The child is poisoned by carbonic dioxid; he is made restless and irritable. He uses up nerve force and energy is wasted. A room temperature of 66° to 68° F. is best under most conditions. There are few households which cannot have a thermometer.

**Ventilation.**—There must always be a communication between the sick room and out of doors. A convenient means of ventilation is the window-board (p. 26).

**Cold Air.**—We are not inclined to advocate cold air to the extreme degree advised by some. A wide open window during illness, such as convalescence from acute pulmonary disease, is an excellent measure if the child is suitably protected by a hood and an extra outer garment. When possible, the patient should have the advantage of two rooms, one for use during the day and one for the night. This is of particular advantage in grip and in the respiratory diseases in which there is a possi-

bility of reinfection. The room which is not occupied should be aired continually.

**Drinking of Water.**—There is no illness of childhood in which water to drink should not be given freely. If there is any question as to its purity, it should be boiled.

**Diet.**—The digestive capacity of every sick child is lessened; this we all appreciate, the degree of incapacity depending largely upon the severity and nature of the illness. In every illness the food strength should be lessened. This we do not all appreciate. For breast-fed babies this is done by giving water, sugar-water, or some cereal decoction, as barley-water, before each nursing, in amount ranging usually from 2 to 3 ounces. This dilutes the mother's milk. The nursing baby is satisfied when his stomach is full. He needs as much fluid as usual, but is unable to digest the usual amount of breast milk. For the bottle fed the food strength is reduced by substituting water for a given quantity of the milk mixture. A safe rule to follow is to reduce the food strength one-half by the addition of water. If the illness is a very severe one of intestinal disorder, whether typhoid fever or summer diarrhea, milk is to be discontinued absolutely, and usually cereal decoctions should be substituted. During a very severe attack of pneumonia or scarlet fever milk is to be also discontinued, and cereal gruels given. If the milk must be withheld for several days milk-sugar may be added to the cereal water substitute so that it shall contain 5 per cent. of milk-sugar. This is obviously to supply fuel for the organism and spare the protein waste. When the usual feeding is continued gastro-intestinal infection is almost sure to add to the burden of the patient through toxins absorbed from the putrefaction of undigested milk in the gut. The resulting tympanites is a very serious feature in respiratory and cardiac diseases. Tympanites embarrasses the action of the overworked or diseased heart and interferes with respiration already sufficiently obstructed by the processes in the lungs or in the pleural cavity. The carbohydrates leave no by-products to be eliminated by the kidneys, thus lessening the work of these diseased organs, and perhaps preventing their involvement in such diseases as scarlet fever and diphtheria by diminishing the amount of irritation to which they may be subjected. In short, we must allow just as much food as the patient can care for. When we give more we diminish the chances of recovery through added toxemia or by interfering with the vital processes.

**Protection from Needless Interference.**—Regardless of the nature of the severe illness we must conserve vitality by disturbing the patient as little as possible. The various attentions to the child should be given at distinct, but reasonably long, intervals. It is rare that a child will need food or medication oftener than once in two hours during the night—three hours answer in most cases. Food and medicine may be given at the same time. Not infrequently one sees cases in consultation where something is being done to the child every hour in the twenty-four. This would exhaust any well child. What can the effect be upon the very ill but to diminish chances of recovery?

**Urine Examination.**—Nephritis is a complication, and a serious one, that may be looked for in all acute diseases of children. An early recognition of this complication is most important. Albumin in the urine is

one of the earliest signs of nephritis, and involvement of the kidneys may be discovered by urine examinations before any of the other signs of nephritis appear. It is a wise custom in scarlet fever and diphtheria, diseases peculiarly liable to nephritic involvement, to examine the urine daily—in other acute diseases with fever, at two- or three-day intervals. This examination is simplified by writing a prescription for 1 ounce of nitric acid (c. p.) and a few test-tubes, which are kept in the sick room. The cold test is sufficient to detect the smallest trace of albumin. When the physician must carry the urine with him or have it sent to his home, the examination is sometimes postponed or otherwise neglected.

**Bowel Function.**—Every nurse or mother is given a standing order that there is to be one evacuation of the bowels daily, and if this does not occur naturally, an enema must be given.

**Bowel Feeding.**—In conditions of collapse in any illness, in coma, and certain gastric disorders particularly, sufficient nourishment cannot be given by the stomach. When such a condition obtains, regardless of the illness, we must resort to colonic feeding (p. 97).

**Measures to Prevent Suppression of the Urine.**—Suppression of the urine is not an unusual occurrence in pediatric practice, and may occur in a wide range of diseases. One of our most successful means of combating this condition is the use of colonic flushings.

**Prevention of Pyrexia.**—High temperature in children, regardless of the nature of the illness, is to be managed by the same methods. The most satisfactory has been the abstraction of heat through the means of hydrotherapy, in the use of sponging and packs (pp. 840-841). It is a popular belief among laymen that cold should not be used in scarlet fever or measles because of some unfavorable influences on the rash. There is no disease of childhood with temperature in which the application of water to the skin does harm. One may use spongings and packs in scarlet fever exactly the same as in pneumonia or typhoid fever.

When is elevation of the temperature to be interfered with? What are the indications that necessitate interference? When we have a degree of temperature that causes restlessness, loss of sleep, rapid heart action, with resulting loss of vitality—*i. e.*, wasted energy—then measures to effect reduction should be instituted. This will be necessary in some cases at 103° F.; in others at 105° F. In other words, we should be governed largely by the effects of the temperature upon the individual and not by the reading of the thermometer. If sponging is employed, it is advisable to use 1 part alcohol with 3 parts of water at about 80° F., the skin being repeatedly moistened with the solution, which is allowed to evaporate. In some cases such a procedure is soothing. In others it occasions no little annoyance, in which event it must not be used.

**Drugs.**—Regardless of the nature of the disease, a full dose of castor oil is of benefit at the beginning of the illness.

When drugs are used it is essential that no harm shall result.

In any illness in a child one requirement is to keep on good terms with the child's digestive tract. In our medication we must seek to protect the stomach. This may be done by giving much of the medication after meals, using it by preference in capsules, powder, or tablet; or when it is administered between meals, by giving it well diluted with

water. When liquid medication is necessary, elixir simplex in small amount is of value as a flavoring medium. Useless syrups are to be avoided. The worst possible custom is the using of heavy syrups for flavoring. The practice of giving the ammonia salts and ipecac, usually with syrup of tolu, to a child with severe bronchitis or bronchopneumonia is wretched: and this is putting it mildly.

**Stimulation.**—Two criticisms of general application relate to the management of sick children. The first is that heart stimulants are used too early and in too large dosage. Second, antipyretic measures are resorted to when such management is not called for. We have already referred to the latter in stating that a child should not necessarily have antipyretic measures used because he has fever with pneumonia, typhoid, or scarlet fever. Neither does he require stimulation because he has typhoid or scarlet fever or pneumonia. Regardless of the nature of the illness, our choice of stimulants is very much the same, and our reason for using them is exactly the same—to assist a heart that needs help. (The employment of heart stimulants will be discussed in detail under proper headings in the different chapters.)

It will be seen from the foregoing that the treatment of different diseases of children has many features in common, and these essentials must be appreciated by every man in order that he do the best work in treating children.

If there is one thing that has been impressed upon those engaged in children's work, it is the necessity of completeness of detail in management. We little realize how sensitive the sick child is, how all nervous effort, all untoward influences, cost something. They cost energy and output of vitality which may be sufficient at times to preclude recovery.

Family co-operation is necessary for success, and will be best obtained through the confidence and affection engendered by thorough, painstaking work on the part of the physician.

**The Sick Room.**—If there is a choice of rooms for the patient, the size of the room and the means of ventilation are important points to be considered in the selection. During cold weather a room with southern exposure, to which the sun has free access, should be chosen. During the hot months of summer, however, the cooler the room, the better, provided the size and ventilation are satisfactory. The furnishings should be of the simplest, only those articles being allowed to remain which are required for the patient. So many of the ailments of childhood are of an infectious nature that only such articles of furniture as can be washed should be used. Curtains, hangings, and plush furniture have no place in a sick room. A plain wooden floor is much better than one that is carpeted. Enameled beds and plain wooden or enameled chairs and tables are best. A painted wall is much better than a papered one. A fireplace is desirable not only for heating purposes but also for ventilation.

A child ill in a dirty, badly ventilated, overfurnished, overheated room is from the first at a decided disadvantage.

**The Window-board.**—The value of this simple device in the sick room may readily be appreciated. For a description the reader is referred to p. 26.

**Written Directions.**—If possible, directions for the care of sick children should be given outside the sick room, so that the physician may have the undivided attention of the mother or nurse. These directions should first be given orally and thoroughly explained, and then written out in detail. When the child is crying, and two or three onlookers are talking, the mother or nurse becomes confused and is almost sure to misunderstand or forget important directions.

If there is not a trained nurse in charge, the doctor should show the mother or nursery maid how to perform the various offices for the child. One can in a few moments be taught how to read the clinical thermometer, how to give a sponge-bath and an enema, and how to do many other things which the changed condition of the child requires. The use of a croup kettle, which may be needed for croup or bronchitis, should always be explained.

The printed form as given below has proved very useful not only in making the directions absolutely plain and unmistakable but also as a great time-saving measure. The expense of printing is but a trifle. *Form A* represents the front of the slip. A few minutes only are required to fill in the blank spaces. *Form B* represents the back of the slip; on this the observations of the preceding twelve or twenty-four hours are entered. One chart may be made to answer for twelve or twenty-four hours, and when the case is finished constitutes a complete record secured with the expenditure of little time and labor.

FORM A

Date	Name	Age	Disease
ORDERS			
Food.		Spray Gargle Throat with	
Temperature to be taken every . . . hrs.		every . . . hrs.	
R 1	every . . . hrs.	Irrigate Throat with	every . . . hrs.
R 2	every . . . hrs.	Irrigate Ear with	every . . . hrs.
R 3	every . . . hrs.	at . . ° F. every . . . hrs.	
Whisky	every . . . hrs.	Irrigate Colon with	at . . ° F. every . . . hrs.
Brandy	every . . . hrs.	Counterirritation with	
Steam Inhalations	every . . . hrs.	Mustard . . . parts	
using		Flour . . . . . parts	
Sponge Bath for . . min. every . . hrs.		to	every . . . hrs.
at . . . ° F. if Temp. reaches . . . ° F.		Give Enema of Soapsuds	
Cool Pack to be given if Temp. reaches		Saline	at . . . ° F.
. . . ° F., and continued until Temp.		at . . . o'clock if necessary.	
falls to . . . ° F., using water at . . . ° F.			

FORM B

Date	CLINICAL NOTES						hour.
Temperature	° F.	° F.	° F.	° F.	° F.	° F.	
Pulse							
Respiration							
Sleep							Nourishment
Skin							
Tongue							Vomiting
Throat							Stools, No. in twenty-four hours
Lungs							character
Heart							Urine, amount, oz., in twenty-four hours.
Abdomen							Blood
Nervous Symptoms							
Special Symptoms							

## DIET DURING ILLNESS

The extent to which the digestive capacity of every child is diminished during illness depends largely upon the age of the child and the severity of the disease. The younger the child, the greater the incapacity. This is fairly constant with all the ailments of childhood, including, of course, those which directly affect the gastro-enteric tract.

**Reduction in Food Strength.** In a moderately severe bronchitis, with a degree or two of fever, the digestive capacity is slightly diminished and a 25 per cent. reduction in the strength of the food will answer. During the critical stage of a lobar pneumonia the digestive powers are held in abeyance and predigested foods and exceptionally alcohol must sustain the patient. During an attack of measles, scarlet fever, bronchopneumonia or diphtheria in a bottle-fed infant, at the height of the disease, it is a good custom to reduce the strength of the food one-half by the addition of water, to make up for the quantity removed. For ailments of lesser severity, such as bronchitis, with a temperature of 100° to 101° F., or chickenpox, or mild measles, one may reduce the strength of the food from one-fourth to one-third. In the event of any mild ailment or injury which confines a child to his bed, the food strength should be cut down, for inactivity as well as disease lessens the digestive capacity.

Among nurslings and the bottle fed these precautions are particularly necessary. A child with fever is apt to be thirsty and to take more fluid than in health. This is frequently the case during summer diarrhea. In order to prevent taking too much food, one should not only order that the milk be diluted for the bottle fed but also instruct the mothers of nurslings to give a drink of water immediately before each nursing and between nursings, and then to allow the child to nurse only one-half or two-thirds the usual time. For the bottle fed, one-half to one-third the contents of each bottle is to be removed and the quantity replaced by boiled water, so that the amount of fluid given remains the same.

If a child is a "runabout" over two years of age he may be given broths and thin gruel—one-half milk and one-half gruel. By carefully watching the stools, thus fitting the food to the child's capacity, we may avoid grave intestinal complications which, during the summer, often prove to be more serious than the original ailment. In the acute gastro-enteric infections and in typhoid fever all milk must at times be discontinued.

The dietetic management of the acute intestinal diseases and typhoid fever is referred to in detail under the respective headings.

**The Art of Feeding in Illness.**—Not only is food often taken in insufficient quantity in illness, but in many cases it is absolutely refused. In other cases, during coma and asthenic states, swallowing is impossible. In delirium and in conditions of collapse nourishment must be given, and when this is impossible by the natural method we have, as temporary substitutes, gavage, rectal feeding, and such expedients as intravenous infusion.

Forcing the child to take nourishment by the mouth is rarely necessary. Coaxing and bribing ordinarily succeed far better. For a child from three to five years of age a bright new penny possesses much persuasive power. The child will usually take food better from one to whom

he is accustomed, like the mother or nursery maid. The trained nurse should understand that while she is unacquainted with the patient, the simpler needs of the child are to be looked after by others to whom the patient is accustomed.

The nourishment should be as palatable as possible and served in bowls, cups, or plates that are attractive to the patient because of color, pictures, or peculiarities of shape. Junket flavored with vanilla, served cold, is a favorite food for sick children of the "runabout" age. Frozen custard and home-made ice-cream, made with one-third cream and two-thirds milk, will usually be well taken. Toast, dry bread, and crackers made in peculiar shapes are attractive to the child. In not a few cases we have succeeded in feeding satisfactorily children two or three years old, when several other schemes had failed, by allowing the temporary return to the bottle, from which they had been weaned for a year or so.

In these difficult feeding cases the child's peculiarities and wishes must be studied. Children in illness require water, but frequently take it in insufficient quantities. Those who refuse plain water will often take ginger ale, sarsaparilla, or vichy. If these drinks are well taken, they may be given freely. In the acute infectious diseases, especially pneumonia, free water drinking is a therapeutic measure of no mean value.

#### TREATMENT OF THE INDIVIDUAL

In these days of specialization one is sometimes impressed with the fact that there is a tendency for the patient, the individual, to be lost sight of, to be overshadowed by the immediate disease or condition from which he may be suffering. With children the success of the treatment in practically every chronic ailment depends upon the vitality of the individual patient and his powers of resistance as a whole, to a much greater degree than is the case with the adult.

The object of taking up this subject is not to be unkindly critical, but to call attention to one phase of management which is not sufficiently appreciated by many who have to deal with children in their professional work.

Not at all infrequently poorly conditioned children, who have been treated for months by local measures for a skin affection, recover without any local treatment whatever (other than an attempt perhaps to relieve the itching) when their lives are ordered according to the requirements of the growing child as regards nutrition, bowel evacuation, sleep, suitable clothing, fresh air, and rational exercise. Cases of chronic rhinitis and bronchitis which may have persisted for weeks respond promptly when local measures, sprays and douches, and the internal use of drugs are suspended and the child's life is directed along rational lines. Those who treat tuberculosis and chronic bone diseases, chronic otitis, chorea, and hysteria, are to be reminded that their work is not half finished when they have directed the usual daily or weekly routine treatment. In these chronic ailments it is folly to expect what a cure really means (a constructive process) on a destructive diet and improper habits of life.

Children possess marked recuperative powers, and the rapidity of progress toward recovery is often most gratifying when right conditions

are instituted as relates to these fundamentals in child management, viz., food, sleep, clothing, and bathing. It is the height of folly to give children iron for anemia and allow them every form of indiscretion in diet.

It should always be remembered that the best results are obtained in the treatment of a child, whatever the nature of his illness, when he has a child's normal existence, and it is only under such conditions that satisfactory results of treatment can be expected.

#### IV. EXAMINATION AND DIAGNOSIS

**Knowledge of the Normal.**—Before a student of diseases of children is shown a sick child he should be made thoroughly familiar with the normal child of approximately the following ages: under three months, one year, three years, five years, and ten years.

The student should learn the normal appearance of the eyes, ears, throat, skin, genitals, and the character of the stools of the various ages. He should be instructed in the examination of the liver, spleen, abdomen, heart, and lungs.

One who teaches diagnosis in children in postgraduate work is repeatedly impressed with the handicap under which many physicians work because of a very indifferent conception of the normal.

Without sufficient ability to examine the canal and drum of the ear, and to know the possibilities for variations within the normal, it is futile to attempt the recognition of disease processes.

Many physicians expert in pulmonary diagnosis in adults are wholly unable to make out even approximately diseased conditions in the lungs of infants and young children. These are all conditions that cannot be taught in a didactic way. Neither can one learn much of the subject through reading. What is required is the examination of the normal infant or young child—not a few examinations, but a very careful routine examination of many infants and young children. Most difficult to determine is the borderland between normal and diseased processes, as evidenced by physical signs.

Diagnosis in children requires ability to estimate the condition as a whole. The fact that the patient cannot describe his symptoms is of more advantage than detriment. The child appears in the perfectly natural condition, without attempt to mislead, with no preconceived ideas or theories. In other words, the child, unless alarmed, is always natural, always himself; this is a very definite aid. Further, the young child has no imagination. He is never hypochondriac. Instead of giving the impression that he is more ill, he is liable to be judged less ill than he really is because of his activities and disinclination to give up. This tendency to remain active may be misleading. When, therefore, a child appears very ill, while the condition may not be dangerous, we may always know that he feels very badly.

Physicians who wish to become expert in diagnosis must first learn the *normal* child from birth until he passes into the adult.

**First Examination.**—Upon being called upon for the first time to see a patient, it is an essential custom in every case to take a history. Below is a copy of a blank history record which has proved of value. Form A represents the front of the slip. Form B represents the back of the same slip. Further records are kept on plain ruled sheets of the same size—5 by 8 inches.

## HISTORY RECORD

## FORM A

Date	Address	Name					
	Mr.	Age					
<b>Family History</b>	Children living	Ch. dead	Cause				
Rheumatism		Tuberculosis	Syphilis				
Nervous Dis.		Alcohol, tea, etc.	Miscarriages				
<b>Personal History</b>	child, born at	Labor					
Sat up at	mo.	Talked at	mo.	Teeth at	mo.	Wt. at B.	lb.
						Walked at	mo.
<b>General Health and Habits</b>							
Appetite		Eats between meals?		Tea, beer, etc.?			
Bowels		Bath		Fresh air			
Sleeps from to		; and from to		Snore? Mouth Br.?			
<b>Previous Diseases</b>	Meas.	Wh. Cg.	C-pox	Scarlet.	Diphth.		
	Mumps.	Sm-pox.					
Gastro-enteric							
Respiratory							
Ear		Throat		Colds			
Diet from Birth		Nursed					
<b>Present History</b>							

## FORM B

## EXAMINATION

Weight	lb.	Height	in.	Circ. Head	in.	Circ. Chest	in.
<b>General Condition</b>			Color		Muscles		Reflexes
Mentality			Sits?	Walks?	Talks?		
<b>Head</b>	Fontanel		Sutures		Craniotabes		
<b>Eyes</b>			Nose	Disch.	Breathing		
<b>Mouth</b>	Tongue		Muc. Memb.		Teeth		
<b>Throat</b>			Tonsil		Adenoids		
<b>Lymph-nodes</b>			Ears		Epitrochlears		
<b>Thorax</b>	Shape		Rosary		Groove		
<b>Heart</b>							
<b>Lungs</b>							
<b>Abdomen</b>			Umbilicus		Liver	Spleen	
<b>Genitals</b>			Skin				
<b>Extremities</b>	Epiphyses		Contour		Feet		
° P. R.	Blood	R.B.C.			Hb.	% W.B.C.	
<b>Urine</b>	React.	S. G.	Alb.	S.	Ind.	Ace.	Mic. Exam.

When the history is completed the leaves are placed in a Moore loose-leaf binder.

The patient's family history is to be carefully taken. The habit of obtaining a complete and accurate record of family peculiarities in relation to disease is often of much service, subsequently, if not at the time. Only upon systematic questioning will necessary facts be brought out relating to tuberculosis, rheumatism, and syphilis. The child's personal history includes the birth weight, the rate of growth, the nature of previous illnesses, present weight, the condition of the skin, eyes, nose, heart, lungs, tongue, bowels, bones, and the temperature. All these points are noted and recorded. It is only by such an examination, requiring much time and patience, that we are able to become thoroughly acquainted with the case in hand.

The child must be stripped for the examination. The conditions found are then entered in the proper spaces in the history chart. After the family history has been taken and the general physical examination is completed, we are in a position to devote ourselves to the present condition of the patient. After one has practised for a time, thoroughly ex-

aming every new case, he is impressed not only with the value of the method as bearing upon the management of the condition in question, but also with the unexpected pathologic findings in perhaps other organs, particularly the heart, throat, and lungs.

**Diagnosis by Inspection.**—We must learn the appearance and bodily habit of the child under normal conditions. Thus the baby of a few weeks cries when hungry, and with inco-ordinate movements of the arms and legs expresses his discomfort. With colic or pain of any nature he also cries, and with inco-ordinate movements of hands and legs makes known his discomfort. But the child's manner of crying and the movements of the body are in no way alike. A baby spoiled and who wants to be taken up also makes a great ado, and yet he acts vastly different than when he is in hunger or pain.

All the above manifestations are vastly different from the cry and the arhythmic movements of early meningitis.

The position in which the child rests in bed often supplies us with very good evidence as to the nature of the trouble. Thus one position is assumed in meningitis, another in paraplegia, and another in scurvy or poliomyelitis. The countenance or the facial expression may be indicative of the disorder. The anxious, flushed countenance of acute pneumonia, with the dilatation of the *ala nasi* and the rapid breathing and grunt, are all strongly suggestive. The sunken eyes, the expressionless countenance, the ashy pallor, the superficial breathing, all characterize the appearance of the patient with intestinal toxemia.

The diagnosis of malnutrition and marasmus is always stamped on the countenance. In cretinism, in Mongolian idiocy, in microcephaly, and other forms of mental deficiency the name of the disorder is written on each countenance, and for diagnosis we need go little further.

The blue-white skin of anemia, the pallor of nephritis, with the fulness about the eyes, are often diagnostic in themselves. Among the transmissible diseases, measles, mumps, and chickenpox are readily diagnosed by inspection. In scarlet fever, also, inspection is our greatest aid.

In hemiplegia the quiet arm and leg, with the other arm and leg in motion, are strongly suggestive as to the nature of the trouble.

The only way in which whooping-cough may be positively diagnosed is to watch the child during a paroxysm.

By inspection we can fairly accurately determine the existence of acute laryngitis or membranous laryngitis. As mentioned elsewhere, the obstruction in acute laryngitis is inspiratory, while in membranous laryngitis it is both expiratory and inspiratory.

The position of the head, the dysphagia, and the peculiar cracked voice mark retropharyngeal abscess. The method or peculiarities of locomotion supply most valuable evidences of Pott's, hip, or other bone and joint disease. In tetany, the "accoucheur's" hand, and the feet in extreme extension, are all that are necessary for diagnosis.

The yellow conjunctivæ and the tinted skin indicate jaundice. In the skin diseases or skin manifestations of any nature inspection again is an important means of diagnosis.

The facial expression due to adenoids is so characteristic that every text-book contains a photograph demonstrating the "adenoid face" (p. 111).

Laryngismus stridulus, convulsions, tonsillitis, rachitis, scurvy, and stomatitis are all diagnosed by inspection.

It will readily be seen what a great aid in diagnosis is possessed by the physician who has trained powers of observation.

*Inspection During Sleep.*—It is of advantage to observe many children when they are asleep and beyond all the influences of their surroundings. In not a few cases correct respiratory observations are possible only when the child is asleep.

## V. MORTALITY AND MORBIDITY

ALL figures from which statistical studies can be made with reference to the etiology of disease and the relative importance of the different causative factors are dependent upon accurate tabulation of births and deaths. Only in the more highly developed nations is the recording of vital statistics carried out with requisite accuracy, and even in 1920 the death registration area of the United States comprised all of only 33 States; and the birth registration area (established in 1915) only 23 States.

Except in the case of the reportable diseases, and then only when the records of a community are kept fairly complete, we still have incomplete data for the study of the incidence of diseases which seldom prove fatal. Many facts, however, are readily obtainable through the United States Census Bureau records and the reports of health departments in large communities. The physician should keep informed concerning those facts which are fundamental. In the preparation of the following paragraphs compilations by Dr. Philip Van Ingen, of New York, have been freely employed.

The death-rate for the first year of life in spite of intensive infant welfare work averages 96.6, while the crude death-rate is 14.6, only one-seventh as high. If the figures for the United States Army in the recent war be taken for comparison, a baby's risk of life during the first year is disclosed to be eight times as great as that of the soldier for a corresponding period.

From 20 to 30 per cent. of the infant mortality is ascribed to accidents at birth or defective developmental conditions operative in the first month of life. No stronger argument could be cited to emphasize the need of responsible obstetric attendants, to say nothing of prenatal care.

The following table includes for purposes of comparison the leading disease groups important in determining the mortality of infancy:

PERCENTAGE OF INFANT DEATHS AT VARIOUS AGES UNDER ONE YEAR FROM CERTAIN CAUSES

(Five-year Averages—Death Registration Area)					
	Infectious diseases.	Respiratory and influenza.	Diarrheal.	Developmental. <sup>1</sup>	All others.
First quarter.....	3.06	11.04	12.46	60.99	12.45
Second quarter.....	9.26	30.60	47.41	11.61	1.42
Third quarter.....	11.42	31.39	38.59	5.05	13.57
Fourth quarter.....	15.66	32.97	34.75	5.18	13.44

Of all the deaths occurring in infancy three-fifths occur in the first quarter and nearly half in the first month of life when the youthful organism is subjected to conditions previously inexperienced, with the added handicap of embryonic defect or birth injury.

<sup>1</sup> Including accidents.

## PERCENTAGE OF INFANT DEATHS AT VARIOUS AGES UNDER ONE YEAR

(Five-year Averages—Death Registration Area)

Under one day.....	15.7	First month.....	45.5	First quarter of year	61.1
First week.....	31.3	Second month.....	8.7	Second quarter "	16.2
Second week.....	6.2	Third month.....	6.9	Third quarter "	12.5
Third week.....	4.4			Fourth quarter "	10.2
Fourth week.....	3.5				

The following table shows the part played by various diseases in the mortality of the first year taken as a whole:

## PERCENTAGE OF INFANT DEATHS DUE TO VARIOUS CAUSES

(Five-year Averages—Death Registration Area)

Typhoid.....	0.04	Influenza.....	2.98	Gastro-intestinal....	20.01
Measles.....	0.96	Tuberculosis:		Congenital malforma-	
Scarlet fever.....	0.08	All forms.....	1.35	tions.....	6.45
Pertussis.....	2.45	Pulmonary.....	0.47	Prematurity and con-	
Diphtheria.....	0.53	General and men-		genital debility....	20.26
Erysipelas.....	0.46	ingeal.....	0.64	Injury at birth.....	3.72
Tetanus.....	0.20	Abdominal.....	0.11	Syphilis.....	1.03
		Other forms.....	0.13		
		Bronchitis.....	2.19		
		Bronchopneumonia..	8.68		
		Pneumonia.....	4.43		

In the study of age groups after the age of one year we are handicapped by the lack of census tabulations of the figures for population by age groups. Until such tabulations are available mortality statistics give only an idea of the relative importance of various diseases as causes of death, and in what period of child life they have the maximum influence.

## PERCENTAGE OF TOTAL DEATHS AT STATED AGES DUE TO CERTAIN CAUSES

(Five-year Averages—Death Registration Area)

	Under one month.	One month and under one year.	Second year.	Third year.	Fourth year.	Fifth year.	Sixth to tenth year.
Measles.....	0.15	1.67	5.14	4.60	3.85	2.99	2.28
Scarlet fever.....	0.01	0.13	0.68	1.71	2.46	2.94	2.71
Diphtheria.....	0.13	0.88	4.37	9.15	12.70	14.33	12.29
Pertussis.....	0.38	4.20	5.05	4.17	3.25	2.53	1.32
Tuberculosis (all forms)....	0.18	2.58	4.91	5.92	6.27	6.57	7.41
Gastro-intestinal.....	5.0	34.70	26.55	14.45	8.90	6.15	3.5
Bronchitis.....	1.10	3.02	2.01	1.50	0.98	0.83	0.35
Bronchopneumonia.....	3.16	13.36	13.55	10.56	7.70	6.23	3.93
Pneumonia.....	1.59	6.85	9.03	9.07	8.23	7.92	7.52
Influenza.....	0.86	4.78	8.54	10.96	11.68	11.63	11.19
Meningitis.....	0.25	1.39	1.86	2.61	2.51	2.65	2.52
Nephritis.....	.....	0.62	0.71	1.19	1.56	1.70	2.14

As a factor in the mortality of infants and children measles is most important in the second year; its greatest influence is during the second, third, and fourth years.

Scarlet fever steadily increases in importance with age, reaching its maximum in the fifth year.

Diphtheria, like measles, becomes important during the second year and steadily increases through the fifth year.

Pertussis becomes important after the first month of life and reaches its maximum in the second year.

Tuberculosis steadily increases with each period.

Gastro-intestinal disease is of greatest importance after the first month throughout the first and second years.

Bronchitis and bronchopneumonia as causes of death exert the greatest influence during the period from one month to two years of age.

Nephritis shows a steady increase in importance with age.

The influence of scarlet fever on the incidence of nephritis indirectly affects the mortality figures for the latter disease.

Through the agencies working to promote better understanding of infant feeding, better obstetrics, and what may be designated by the general term "improved baby hygiene," a rapid reduction in infant mortality in many communities is being obtained. New York City has well illustrated the effectiveness of work along this line.

TABLE SHOWING REDUCTION IN INFANT MORTALITY RATE IN NEW YORK CITY—PROGRESSIVE AVERAGES<sup>1</sup>

	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	Percent. changes.
Scarlet fever.....	0.36	0.30	0.27	0.19	0.15	0.10	0.07	0.06	0.04	0.04	-88.8
Gastro-intestinal.....	39.40	35.35	32.01	27.02	24.42	23.61	22.28	21.92	19.52	18.45	-53.2
Diphtheria.....	1.57	1.35	1.13	0.97	0.96	1.03	1.04	0.98	0.84	0.78	-50.4
Measles.....	1.67	1.50	1.33	1.41	1.32	1.19	1.12	1.15	1.25	1.01	-39.8
Tuberculosis.....	2.31	2.36	2.23	2.15	1.95	1.94	1.88	1.87	1.80	1.67	-27.5
Respiratory.....	25.95	26.06	24.00	23.38	22.06	21.46	20.43	19.88	20.43	19.40	-25.2
Development.....	28.78	29.63	30.32	30.75	30.43	29.95	28.75	27.41	26.97	26.91	-6.5
Injuries at birth.....	.....	.....	3.12	3.31	3.48	3.62	3.82	4.01	4.17	4.17	33.4
Pertussis.....	1.14	1.38	1.22	1.31	1.19	1.34	1.31	1.52	1.77	1.53	34.1
Infant mortality rate.....	127	122	114.0	106.0	101.0	99.0	96.0	92.0	91.0	87.0	31.5
Neonatal.....	.....	.....	39.7	38.7	37.7	36.7	36.3	36.3	36.7	36.0	9.3

<sup>1</sup>These figures are *progressive averages*. A fairer idea of progress is obtained by averages than by figures for single years. "Progressive Averages" are averages for three consecutive years, the last figure in each group of 3 being consecutive. Thus 1910 is three-year average 1908-10; 1911 is three year average 1909-11, etc.

Throughout this book under the heading "Prognosis" an attempt is made to give some idea of the influence of various specific conditions to which the patient is subjected upon the chances of recovery from a given disease. Only by bedside observation coupled with a knowledge of probabilities dependent on statistical studies is the ability to make fairly accurate prognosis acquired.

## VI. THE NEWBORN

### PREMATURE AND CONGENITALLY WEAK INFANTS

COMPARATIVELY few infants born before the completion of the twenty-eighth week of pregnancy survive the first year. Reported cases of survival of those born before that time are usually unreliable, as the reports seldom follow the child beyond the third month. The prognosis is influenced by the factors causing the premature birth. If syphilis is present, the child may survive but a day or two. Children whose births are forced because of kidney disease in the mother do not appear to do as well as others. In children's institutions we have treated a large number of premature infants and have had anything but brilliant results with them. They not infrequently live to be two, three, or four months of age or older, but on account of reduced vitality they readily succumb to the slightest ailment, a mild bronchitis or fermentative diarrhea being sufficient to terminate their existence.

In the management of the premature and delicate newborn there are four points to be considered—the air the child gets to breathe, the nourishment, the maintenance of bodily heat, and the danger of infection. It is also to be remembered that we are dealing with an undeveloped body which is not ready for the environment in which it is placed. The premature baby should be handled only when necessary, and then in the gentlest manner. Bathing is often best omitted for the first few weeks, oil being used for cleansing purposes. Because of the undeveloped parenchyma of the lungs unusually good fresh air is required. Because of the undeveloped heat centers the body heat of these infants is quickly lost and must be maintained by artificial means. The stomach is small and the digestive processes are undeveloped and weak, so that the nourishment should be of the most easily assimilable character.

**Artificial Heat.**—The maintenance of heat is of the utmost importance. For this purpose incubators and their various modifications have been used from time to time. They may, under careful watching, maintain an even temperature, but practically all have been defective in supplying fresh air to the child. Incubator babies invariably are prone to do badly.

The padded crib with the child wrapped in cotton and surrounded by hot-water bottles is a safe means of maintaining the temperature. A thermometer should rest between the cotton and the bed-clothing as a guide to the nurses in the use of the hot-water bottles. Ordinarily this should register between 85° and 90° F., depending upon the temperature of the child, whose rectal temperature should at first be taken frequently. If there is a tendency for his temperature to be greatly reduced—below 95° F.—more external heat will be necessary than if his temperature is 97° or 98° F. Various beds and devices on the market for the premature are rather fanciful affairs, but of no greater service than those perhaps more crude. Means and methods complicated in char-

acter are to be avoided in treating children in the home. The best means of maintaining adequate warmth without sacrifice of ventilation is afforded by the premature ward of a hospital.

**Room Temperature.**—The temperature of the room should be maintained at about 80° F., and not under 75° F.

**Fresh Air.**—Suitable ventilation may be secured by the window-board device (p. 26).

**Absence of Infection.**—Only the nurse and rarely the physician should be allowed in the room. Infection of any nature is a very serious matter. The family generally, and visitors always, should be excluded from the presence of the premature.

**Feeding of Premature Infants.**—Breast milk for premature infants born under twenty-eight weeks is almost a necessity, and should always be procured when possible for all premature children. The mother, with the rarest exception, is unable to supply it, so that a wet-nurse should be secured. In selecting a wet-nurse for a premature baby it is advisable to take the wet-nurse's baby also, as the premature infant may not be able to nurse, or if he nurses will not take all the milk. Pumping the breasts of a wet-nurse will almost invariably dry them up if her own baby is not with her to furnish the necessary stimulation of nursing. Sufficient milk may be removed by the breast-pump to supply the premature infant if he is unable to nurse, and the wet-nurse's baby will empty the breast. For premature babies who refuse the breast or are unable to take a nipple, the Breck feeder (Fig. 19) may be used as a means of giving nourishment; or gavage (p. 853) may be brought into use. To this we are obliged to resort in rare cases. The Breck feeder consists of a graduated glass tube, narrowed at one end. Over this end is placed a small rubber nipple, the other end being closed by a flexible rubber cap. Suction on the nipple is aided and encouraged by pressure on the air-filled cap.



Fig. 19.—The Breck feeder.

If the breast milk proves too strong, it may be diluted with equal parts of a 6 per cent. sugar solution, from  $\frac{1}{2}$  to 1 ounce of the mixture being given at first at intervals of from one to one and one-half hours. Fourteen to fifteen feedings may be given in the twenty-four hours, the amount depending upon the child's digestive ability.

If human milk is not obtainable, whey made from whole milk may be given, the nutritional equivalent of which is approximately 1 per cent. fat, 1 per cent. protein, 3.5 per cent. sugar; or 1 ounce of gravity cream may be given with 1 ounce of milk-sugar and 15 ounces of water, which affords a nutritional equivalent of 1 per cent. fat, 5 per cent. sugar, and 0.3 per cent. protein. Evaporated milk (p. 78) is a useful means of feeding in these cases. The food strength is increased, the intervals are made longer, and the feedings larger as the patient proves able to assimilate the food.

The premature child requires unusual advantages, and even when

but one month premature, rarely "catches up" during the first year, sometimes not for two or three years.

## DISEASES OF THE NEWBORN

### CEPHALHEMATOMA

These tumors are usually situated at the site of the caput succedaneum, and are composed of blood. Sometimes pressure of the forceps is accountable for their presence, but rarely can any injury be found. During a long and tedious labor the pressure on the blood-vessels of the scalp is increased, and this is thought to be an active cause in the formation of these tumors. Blood changes are also cited as a possible etiologic factor. The cause cannot be ascribed entirely to pressure against the presenting part, as we find cephalhematomata in breech as well as in vertex presentations. The hematomata are of three varieties, as shown by Fig. 20.

Double cephalhematoma may exist.

**Pathology.**—These tumors are generally situated over the parietal bones. The scalp may show small hemorrhages and ecchymotic areas. The tumor itself is composed of blood. Soon after birth the blood is

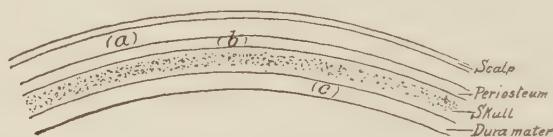


Fig. 20.—Varieties of cephalhematoma: *a*, Between scalp and periosteum; *b*, between periosteum and skull; *c*, between skull and dura mater.

usually in a fluid state, while in later cases coagulation has taken place. The tumor may be infected with pus-forming bacteria and an abscess may result.

**Symptoms.**—At a time varying from the first to the fifth day of life a tumor is seen occupying a position generally over the parietal bones. It is soft, gradually increases in size for about a week, and then diminishes; infrequently a ridge develops around the outer border of the tumor, giving the sensation upon pressure of a depressed fracture.

During the latter stage of the tumor a crackling sensation will be elicited on pressure by the fingers. There is no accompanying fever. The child shows no annoyance. The tumor does not pulsate. One must be careful not to confound this condition with scalp edema, as seen in fracture of the skull after severe traumatism. In uncomplicated cases the tumor gradually becomes smaller and smaller, until finally, after some five to twelve weeks, it disappears, sometimes leaving a slightly raised, uneven, bony base.

**Differential Diagnosis.**—*Encephalocoele* occurs along the lines of sutures or at the fontanels. Pressure may cause convulsions. With movements of respiration, the swelling may vary in prominence.

*Hydrocephalus.*—The head enlarges as a whole, showing separated sutures and large fontanels.

*Caput succedaneum* is edematous, does not fluctuate, and disappears on the second day.

*Depressed Fracture of Skull.*—Depression exists and not a tumor.

**Prognosis.**—In the uncomplicated cases the prognosis is usually good. The prognosis depends upon the amount of injury to the parts and the occurrence of any infection. Internal cephalhematoma with effusion is invariably fatal.

**Treatment.**—These tumors are usually absorbed if let alone. Care should be exercised that no injury may happen to them during handling the infant. No dressing is necessary. In infected cases, where the formation of an abscess has occurred, incision and drainage are indicated.

### HEMATOMA OF THE STERNOCLEIDOMASTOID

This condition is the result of trauma which takes place during delivery. The muscle is torn as the result of pulling by forceps or manipulation on the part of the accoucheur in the endeavor to bring down the after-coming head in breech cases.

The injury consists in a rupture of the muscle-fibers and blood-vessels. A tumor forms within the muscle sheath, which may be small or large, involving the muscle structure in its entire width. There is always an associated contraction of the muscle, which places the head in the wry-neck position, drawn toward the affected side. The tumor is usually located in the lower third of the muscle. Occasionally it is located immediately at the attachment to the clavicle.

The tendency of these cases is toward complete recovery. The tumor is absorbed, but a shorter muscle is sometimes left, which holds the head in the characteristic position.

**Treatment.**—It has seemed from the observation of a large number of cases that massage hastened the absorption of the tumor. The massage should be practised for fifteen minutes three times a day. At the same time a moderate stretching of the muscle should be attempted by rotating the head toward the unaffected side and upward.

All cases eventually make complete recoveries.

### SCLEREMA

Sclerema neonatorum (Underwood's disease) is a rare affection of early infancy characterized by progressive induration of the skin.

**Etiology.**—The condition may be present at birth. The majority of the cases develop before the tenth day of life. Nearly all the reported cases have occurred in premature infants or those weakened by pre-existing diarrhea or pneumonia. Poor hygienic surroundings are included among the possible predisposing causes.

**Pathology.** Parrot described the essential process as a drying up and thickening of the skin, associated with a diminution in the fatty elements of the underlying connective tissue. Langer ascribed the condition to a solidification of the fat as a result of low body temperature, a phenomenon more readily possible in the newborn infant than in the older subject, because of the peculiar chemical composition of infant fat and its corresponding property of solidifying at a relatively high

temperature (89.6° F.). Other authorities have likened the cutaneous changes of sclerema to those occurring in myxedema. Mensi<sup>1</sup> distinguished three types of sclerema, depending upon the degree of atrophy in the skin. In all the forms atrophy of the subcutaneous connective tissue was the chief lesion. Northrup reported a case in which microscopic examination of the skin revealed nothing abnormal.

**Symptoms.**—The chief general symptoms comprise progressive emaciation and asthenia, subnormal temperature, and failing pulse and respiration. The thickening and hardening of the integument begin, as a rule, in the lower extremities, and extend upward to the trunk and face. The skin assumes a yellowish, waxy hue, and later becomes livid and perhaps mottled. It is extremely tense, does not pit on pressure, and imparts stiffness to the motions of the joints and the play of the muscles of the face. Sucking and swallowing may be prevented. The infant usually dies within a few days, but exceptionally may survive the disease. Dr. Lotta Meyers<sup>2</sup> reported a mild case in a female infant, without the usual subnormal temperature, death occurring on the twenty-fifth day.

**Prognosis.**—The disease is frequently, but not invariably, fatal.

**Diagnosis.**—Scleroderma and scleredema, the only conditions resembling sclerema, may be distinguished by the fact that the first has not been noted before the second year (Stelwagon), while scleredema is seldom generalized or accompanied by extreme wasting, and does not deprive the skin of its color or elasticity under pressure.

**Treatment.**—The only management of possible value consists in the maintenance of nutrition and bodily heat. In suitable cases the incubator may be used.

### ASPHYXIA NEONATORUM

Asphyxia neonatorum is a condition of the newborn of grave menace requiring the most active and intelligent treatment.

**Etiology.**—The asphyxia is due to a subaëration of the blood of the fetus or infant. This subaëration may be caused by anything which tends to retard the interchange of carbon dioxid and oxygen in the fetal circulation, and may take place before or during labor. As a result of the interference of the placental interchange of gases, the products of metabolism in the fetus stimulate the inactive respiratory center. This at first causes respiratory efforts, with the aspiration of more or less air, meconium, or amniotic fluid, according to the infant's position in the parturient tract, and later, if the subaëration is not relieved by the quick extraction of the child, allowing access of air for the expansion of the lungs, depression of the respiratory center is the result.

The causes operating antepartum include any conditions which interfere with the oxidation of the mother's blood, such as cardiac or respiratory disease in the mother, hemorrhage, or eclampsia; anything which causes a premature separation of the placenta, such as placenta prævia or accidental hemorrhage; and anything which causes pressure upon the cord or the child, as the premature rupture of the membranes,

<sup>1</sup> Jour. Cutaneous Diseases, October, 1912.

<sup>2</sup> Ibid., 1909.

maternal convulsions, or tetanic contractions of the uterus. During labor, likewise, pressure upon the cord from prolapse or malposition, pressure upon the head, with or without meningeal hemorrhage, or separation of the placenta before the delivery of the head, as in "vaginal birth," may cause asphyxia. Prematurity and congenital disability or defects, such as atresia of the pulmonary artery, may be causative factors inherent in the child.

**Pathology.**—The pathologic changes are due to the venous engorgement and the aspiration of fluids. The right heart is distended with fluid blood or soft clots; the vena cava, the large thoracic veins, the sinuses of the dura, and the hepatic vessels are also distended. The pulmonary vessels may be distended or not, according to the extent and degree of respiratory efforts made. As a result of aspiration the trachea and bronchi may be quite filled with mucus, meconium, blood, and amniotic fluid. The lungs may show areas of atelectasis, or may be partially aerated and intensely engorged. The liver is dark bluish in color. There may be punctate hemorrhages in various parts of the body.

**Symptomatology.**—It has been customary to divide the symptoms of asphyxia neonatorum into two groups, according to the color of the child and the state of the musculature—asphyxia livida and asphyxia pallida. They are essentially the same condition, asphyxia pallida being the terminal stage of asphyxia livida, and a case of asphyxia pallida (if recovery takes place) passing through the stage of asphyxia livida.

**Asphyxia Livida.**—The child who is in the condition of asphyxia livida presents a characteristic appearance: the skin is blue or livid, the mucous membranes are dusky, the sclerotics are congested. The pupils are equal and react, and the position of the eyes is normal. The respiratory efforts are infrequent and gasping. The heart action is rapid and tumultuous, and the heart sounds are loud. The umbilical vessels are engorged and pulsate forcibly. The muscles are everywhere tense; the reflexes are active; the cutaneous sensibility is preserved, and the skin is warm. The anal sphincter functionates. The condition is a sthenic one, and analogous to the convulsive stage of ordinary asphyxia.

A child in this form of asphyxia may recover by the respirations becoming more frequent, the color changing to normal hue, the over-acting heart quieting down, and a normal condition appearing; or the condition may pass by gradual stages into the other form—asphyxia pallida. The degree of asphyxia in the beginning may be midway between the two types.

**Asphyxia Pallida.**—The child with asphyxia pallida is limp and pale. The entire musculature is relaxed, the lower jaw and head hang down, and the limbs drop. Respiratory efforts are absent altogether or so slight as to escape detection. The cord is flabby, the pulsation is inappreciable, or can be hardly felt, and the cord, when cut, bleeds very little. The heart sounds are usually faintly heard and may be slow or rapid. The sphincter ani is relaxed and allows the passage of meconium. The subcutaneous sensibility and reflexes are abolished. The temperature is lowered 1 to 3 degrees. In this form spontaneous recovery almost never takes place.

**Diagnosis.** The diagnosis of asphyxia neonatorum may be made intrapartum by detecting the slowing of a previously well-acting fetal heart, the passage of meconium in the liquor amnii, the trembling of the head in a breech extraction, and the so-called vaginal cry. Postpartum, the condition is recognized by the symptoms as detailed. Asphyxia neonatorum must occasionally be differentiated from meningeal hemorrhage, which is likewise caused by prolonged labor and which often occurs with asphyxia. When the hemorrhage is large, it can be readily recognized by the bulging, tense fontanel and by the existence of coma and possibly paralysis. Hemorrhage may affect the respiratory center, in which event the two conditions are really one.

**Prognosis.**—The prognosis without treatment is always bad. In cases of asphyxia pallida spontaneous recovery is rare, and even with the most active treatment many do not survive. After apparent recovery death may yet occur from weakness or injuries incidental to the initial asphyxia. Idiocy and feeble-mindedness may often be due to the same cause.

**Prophylaxis.**—In the treatment of asphyxia prevention belongs to the province of the obstetrician. Everything should be done to avoid any of the maternal causative factors, and in the conduct of labor itself the aim of the physician should be to deliver the child as quickly as is compatible with safety, not hesitating to apply low or medium forceps in preference to a long and tedious second stage.

**Treatment.**—The active treatment is directed toward maintenance of body heat and stimulation of respiration. The child, as soon as born, should be wrapped up, and if asphyxia exists, active treatment should immediately be instituted. The mouth and throat should be wiped free of the mucus, which will almost invariably be found, by means of the index-finger well wrapped with absorbent cotton or sterile gauze. It may be necessary to suck out the secretions by means of a catheter and a glass tube with a bulb on it to prevent the secretions from the mouth of the physician or nurse getting into the child's pharynx. This will be especially necessary when, as the result of respiratory efforts during the passage of the head through the pelvis, much amniotic fluid, mucus, etc., may have been aspirated. It is not advisable, however, to attempt much instrumentation of the larynx, but to rely on Schultze's method for bringing out aspirated secretions. The respiratory center must be stimulated. This may be attempted, depending upon the severity of the asphyxia, by tickling the nares, by administering the fumes of ammonia, by spanking ("flagellating the buttocks," Koplik), by the alternate use of hot (110° F.) and cold (60° F.) baths, the child being transferred rapidly from one to the other, always ending with the hot one, or by combining with these one of the various methods of artificial respiration, of which the simplest is perhaps the mouth-to-mouth method. Sometimes bleeding of the cord will relieve the intense congestion of the right heart and large thoracic veins, and allow the heart to restore the circulation and relieve the respiratory center. The most commonly used methods of artificial respiration are those of Laborde, Dew, and Schultze.

The *Laborde method* consists in making rhythmic traction on the

tongue, from twelve to fourteen times a minute, which it is claimed excites respiration.

The *Dew method* consists in grasping the infant by the back of the neck with one hand and by the knees with the other. The upper and lower portions of the child are then approximated by a flexion of the thorax on the abdomen, and the reverse movement, extension, is next effected. Alternate flexion and extension are thus practised fifteen to twenty times a minute.

*Schultze's method* as described by him and quoted by Edgar<sup>1</sup> is as follows: "The child lying upon its back is grasped by the shoulders, the open hand having been slipped beneath the head. The last three fingers remain extended in contact with the back, while each index-finger is inserted into an axilla, the thumbs lying upon and in front of the shoulders. When the child thus held is allowed to hang suspended, its entire weight rests upon the two fingers in the armpits. It is now swung forward and upward, the operator's hands going to the height of his own head; the pelvic end of the child rises above its head and falls slowly toward the operator by its own weight, flexion occurring in the lumbar region. The thumbs in front of the shoulders compress the chest, while the hyperflexed lumbar vertebrae and pelvis compress the abdomen, and through it the thorax; finally, the last three fingers on each side compress the thorax laterally. As a result of this maneuver, when properly done, aspirated secretions flow abundantly from the mouth. The distended heart also feels the compression which forces the blood into the arteries. The child is now swung back into its original position and supported entirely by the fingers in the axilla. The compression of the thumbs and last three fingers is removed. The downward swing elevates the sternum and ribs, while gravitation and the traction of the intestines depress the diaphragm. It is often possible to hear the air rush into the infant's glottis as it reaches the original position, although this can occur in a cadaver. The amplification of the thorax lowers the intracardiac pressure. The child should be swung up and down ten times for the space of a minute. The effects of the maneuver should be as follows: the heart beat increases in frequency, the cadaveric pallor of the skin becomes replaced by a rosy hue, and the muscular tonus appears. The child is then placed in a warm bath and watched. If the inspirations are superficial, a momentary dip in cold water is indicated. If the heart action becomes poor, the child should be swung again. If prolonged swinging becomes necessary, the root of the tongue should be compressed forward in order to raise the epiglottis and permit the removal of secretions with the fingers. In premature children the thoracic walls are often too soft to benefit by the compression of the fingers. In these cases insufflation of air should be practised."

In the cases of asphyxia livida, where the reflexes and the cutaneous sensibility are abolished, all attention should be devoted to the general stimulation of the child. The cord should be cut at once; it will often not bleed at all. The air passages should be freed from accumulated secretions as before. The child should be put into a warm bath and artificial respiration attempted by the mouth-to-mouth method or La-

<sup>1</sup> Edgar, Practice of Obstetrics, 5th ed., p. 791.

borde's method. Rectal injection of 1 to 2 ounces of coffee infusion, or hypodermic injection of  $\frac{x}{60}$  grain of strychnin, may be given and repeated in half an hour.

Signs of recovery in asphyxia pallida are a return of the cutaneous sensibility, a reappearance of the reflexes, an increase of the tonicity of the muscles, one or more respirations, or a gradually increasing cyanosis and venous engorgement approximating the condition of asphyxia livida. Finally, a gradual change to normal hue, with restored respiration and relaxation, indicates recovery.

A strict watch must be kept over the child for several days, for relapses are common. Oxygen must be at hand, and all apparatus ready for a resumption of the active treatment at any moment.

### DELAYED ASPHYXIA

Asphyxia may occur after birth in a child who has had an uneventful delivery and who appears quite normal when born.

**Etiology.**—This form of asphyxia is due to some cause interfering with the proper continuance of the respiratory function. Developmental anomalies, such as defects of the nervous system, the heart, the diaphragm, the thoracic walls, or the lungs, or the general weakness of prematurity, may be the cause. Compression of the trachea by enlarged thyroids, and possibly by thymus glands, has been reported. Syphilitic pneumonia or bilateral pleuritic effusions or an enlarged liver may be the etiologic factors.

**Symptoms.**—The clinical symptoms correspond closely to those of ordinary asphyxia. The infant makes very feeble respiratory efforts or none at all; the heart beats with considerable strength, becoming weak as the asphyxia continues and approaches the stage of flaccidity.

**Prognosis.**—The prognosis is dependent upon the severity of the asphyxia and the removability of the cause.

**Treatment.**—Treatment is that of any form of asphyxia, and consists in stimulating respiration and circulation upon the removal of the cause. Asphyxia due to prematurity should be treated according to the methods advised for caring for premature babies (p. 164).

### ATELECTASIS

Atelectasis may be present in the newborn who come into the world asphyxiated, and it is not infrequently seen when there has been a prolonged, difficult delivery. Atelectasis may be the result of weakness, pure and simple, and is not of unusual occurrence in the premature. For some reason there is a failure or inability to dilate the air vesicles. Sudden collapse may occur in marantic infants, the child dying in a few moments with cyanosis and orthopnea, the autopsy proving the diagnosis of atelectasis. The condition may be produced also through compression of the lung with exudation in pleurisy, or by the obstruction of a bronchus with mucus. The most dangerous types are those which are present in the newborn and which occur in the weakly during early life. The warning symptoms are usually cyanosis and rapid superficial breathing, with or without convulsions.

**Treatment.**—The management of atelectasis, both in the newborn, who come into the world asphyxiated because of prolonged difficult delivery, and in those in whom the condition is the result of weakness, consists in making the child cry lustily. If auscultation over the lower lobes posteriorly does not show free vesicular breathing, the child should be made to cry every day, either by spanking or by plunging him first into water at 110° F. and again into cold water at 60° F., our object being to induce vigorous crying and thus dilate the air vesicles. A recent patient made satisfactory improvement by receiving oxygen inhalations for one minute out of every fifteen, with stimulation of various kinds to induce crying. Atelectasis from obstruction of a bronchus or from compression is usually readily relieved when the source of the trouble is removed. In out-patient work we occasionally see marantic young infants in whom there is an involvement of a considerable area of one of the lower lobes posteriorly without any sign whatever of discomfort. The process of resolution in these cases progresses from the periphery toward the center and is very slow. The condition is probably of much more frequent occurrence than is generally supposed, if we are to judge from the autopsy findings in cases of young infants, particularly in institutions.

### SEPSIS IN THE NEWBORN

The newborn infant is peculiarly susceptible to infections, particularly with pyogenic bacteria. During this early period of life the normal bodily defenses are weakened. Phagocytosis, which is the great protector of the adult, is of little service to the newborn, who display little resistance against any bacterial invasion.

**Etiology.**—The cause of sepsis in the newborn is the entrance of some form of pathogenic bacteria into the body. These bacteria are usually of the streptococcus or the staphylococcus groups. The pneumococcus, the colon bacillus, and *Bacillus pyocyaneus* may also cause the condition. These bacteria have been shown to exist even in normal breast milk, and they lurk in the air of hospital wards and dwellings. The lochia and amniotic fluid of the mother have been shown to contain them. The newborn infant is thus surrounded on all sides by bacteria ready to gain admission to his body. The severity of a given case of sepsis is proportionate to the degree of virulence of the bacteria at the time of the infection.

**Sources of Infection.**—Infection may occur through the mouth, which is probably the most frequent port of entry, through the nose, the skin, the rectum, the conjunctivæ, the digestive tract, the lungs, the ears, the urethra, the umbilicus, and, in girls, the vagina. Almost any portion of the body may be the seat of the infection. It is rare to find only one organ or structure affected. Usually two or more portions of the body are involved in the septic process.

**Parts Most Frequently Involved.**—The following parts of the body are most frequently involved:

**Umbilicus.**—The seat of this infection is usually about, or in the substance of, the stump of the umbilical cord. The skin and tissues about the umbilicus are red, indurated, and show the usual signs of septic

infiltration. The blood-vessels of the cord may be the seat of inflammation.

*Peritoneum.*—Peritonitis may follow the extension of the septic process from the umbilical cord to the peritoneum, and under such conditions often results fatally. The peritonitis may be local or general.

*Joints.*—The joint surfaces and membranes may be the seat of suppuration, or osteomyelitis may occur. Sometimes the epiphysis only is involved, and in other cases the shaft of the bone is affected.

*Skin.*—Single or multiple abscesses of the skin and underlying cellular structures are also not infrequent.

*Lungs.*—Pneumonia, usually of the bronchial variety, may develop as a septic process, with only vague symptoms, such as rapid respiration and cyanosis, accompanying the fever.

*Intestines.*—Diarrhea accompanies nearly all forms of sepsis in the newborn. Vomiting may occur.

*Brain.*—The meninges are rarely attacked by the septic process, and when they are involved, indefinite symptoms of meningitis are the result.

*Heart.*—Septic pericarditis may occur, but is extremely rare. Septic endocarditis is more common.

Gonorrheal sepsis is discussed separately (pp. 178, 518 and 794).

**Prophylaxis.**—This is of the greatest importance in guarding against sepsis. The obstetrician's hands and those of the nurse should be just as sterile when handling the newborn infant as they are in caring for the mother. Asepsis should be stringently observed in ligating the cord. The mother's breasts and nipples should be cleansed with boric acid before and after each nursing.

**Prognosis.**—Even in its mildest form, septic infection of the newborn is very serious. When structures such as the peritoneum, brain, pericardium, or lungs are involved, the disease is invariably fatal.

The red cells are decreased by disintegration, while the leukocytes are increased.

**Treatment.**—The management resolves itself into relieving the system of the infection, which is possible when its seat is in the skin. When there is multiple abscess formation, incision should be made and followed by a wet dressing of a saturated solution of boric acid, or, if the area is not too large, a 1 : 5000 solution of bichlorid. If the site of the infection is at the umbilicus, the suppurating surface should be thoroughly cleansed and kept covered with a wet dressing of 1 : 5000 bichlorid, which should be changed at least every two hours. If there is erysipelas, an ointment composed of 30 per cent. ichthyol in vaselin affords one of the best dressings. This should be freshly applied every four hours.

The septic infant, whether the infection is mild or severe, usually nurses very poorly. Often both breast and bottle are refused. When a sufficient amount of fluid is not taken, plain boiled water or sugar water, 5 per cent., or completely peptonized skimmed milk, may be given by gavage. If fluids are not given, the child is very apt to develop inanition fever, which, added to the infection, makes a serious condition more serious. From 2 to 4 ounces of a normal salt solution used lukewarm,

injected into the descending colon through a catheter, will often be retained, with beneficial results. It should not be repeated oftener than once in six hours.

*Early transfusion* in sepsis neonatorum deserves the place of a routine procedure.

Medication other than small doses of alcohol—5 drops of brandy, well diluted, every hour, if necessary—has been without avail in our cases. The prognosis at best is very grave, although cases in which the vital organs are not involved occasionally recover.

*Illustrative Case.*—An unusual instance of infection which ended in recovery was that of a child who had no fever, but lost rapidly in weight and experienced marked prostration. The skin took on a greenish hue, and we were at a loss to discover the cause of the illness. The infection was suspected, but no portal of entry could be found; neither could we find any localized process until the nurse discovered that the umbilicus and the surrounding skin were bathed in pus. The umbilicus had apparently healed without any indication of local trouble. Investigation showed, however, that the infection had entered at this site, and, extending along the vein or artery, had become pocketed and formed an abscess  $1\frac{1}{2}$  inches deep. Enlarging the opening at the umbilicus and establishing free drainage were followed by a gradual closure of the abscess cavity and recovery.

### THE CARE OF THE STUMP OF THE UMBILICAL CORD

Emphasis must be laid upon all procedures tending to diminish the incidence of sepsis.

The management of granuloma, polypus, and localized eczema about the umbilicus will be referred to elsewhere. In order to secure a rapid and complete cicatrization after the cord falls it is essential that the parts be kept dry. Gratifying success has been obtained with a powder composed as follows:

R.	Pulveris acidi salicylici.	gr. x
	Pulveris acidi borici.	gr. xxv
	Pulveris amyli,	
	Pulveris zinci oxidi.	āā ʒss

### UMBILICAL GRANULOMA

A granuloma at the umbilicus consists of a reddish, secreting mass of granulations involving the umbilical stump. It may vary in size between that of the head of a pin and a pea. Granulomata usually occur in cases in which the care of the cord has been neglected. In out-patient work they are very frequently seen, and occur usually in children who have been delivered by midwives. The mother brings the child to the dispensary with the story that the navel will not heal.

The granulations are very vascular and bleed readily.

**Treatment.**—After thorough cleansing of the parts, one or more applications of a 50 per cent. nitrate of silver solution, followed by the free use of an absorbent dusting-powder, soon produces a normal cicatrix. A powder of the following composition is recommended:

R.	Acidi salicylici.	gr. xv
	Acidi borici.	gr. xxv
	Pulveris zinci oxid,i	
	Pulveris amyli.	āā ʒj

The powder should be applied very freely at two-hour intervals during the day, or at least often enough to keep the wound dry.

### UMBILICAL POLYP

An umbilical polyp is usually the result of an overgrowth or an outgrowth of a neglected granuloma. The mass, which may vary in size from a flaxseed to a pea, is reddened, moist, and usually bathed in a viscid, mucopurulent secretion. There is often considerable excoriation of the skin about the umbilical opening. Sometimes the mass is so small that it is hidden by the overlapping folds of skin and its presence would not be suspected but for the secretion which keeps the parts moist. The polyps are very vascular.

**Treatment.**—Cutting the pedicle and applying nitrate of silver or carbolic acid is not a safe procedure. Severe hemorrhage has followed such treatment. About twenty-five years ago the senior author was obliged to sit for three hours by the side of a crying, wriggling child making pressure on the cut stump of an umbilical polyp after a colleague had cut the pedicle. In no other way could the hemorrhage be controlled. The best management in these cases is to ligate the pedicle and allow the polyp to wither and drop off. The powder referred to under the head of Granuloma should be applied after the ligature is fixed, and reapplied frequently before and after the polyp has dropped off, until the wound is cicatrized and dry.

### CONGENITAL UMBILICAL HERNIA

This subject is discussed under the general topic of Hernia (p. 283).

### MASTITIS IN THE NEWBORN

Inflammation of the breasts in the newborn, both in the male and in the female, is seen with considerable frequency in hospital practice. The mammary glands may be acutely tender and swollen to several times their normal size. These glands in young infants should not be pressed or manipulated in any way more than is required for cleanliness. Not a few out-patient cases of mastitis have been due to the attempts of a midwife to express the milk from the breasts. The cases are explained by the fact that the opening of the nipple is large and the gland readily becomes infected from unwashed hands or unclean wearing apparel.

**Treatment.**—The cases have usually responded well to the application of ichthyol—25 per cent. in oxid of zinc, U. S. P. The ointment is spread generously upon old linen which has been boiled and dried, and is then gently bound upon the inflamed gland. Over this is placed oiled silk to protect the clothing, and over all a gauze bandage is applied with very light pressure. The dressing should be changed and fresh ointment applied every six hours. Wet dressings in the management of this condition in infants are not advised. In 5 cases the mastitis was beyond control when first seen, and suppuration of the gland—mammary abscess—followed, requiring incision and drainage, with loss of the gland substance.

## MAMMARY ABSCESS IN INFANTS

Mammary abscess is the result of mastitis which has failed to undergo resolution. It occurs as frequently in males as in females. All the senior author's cases but 2 were seen in institutions or in out-patient work. In 5 the abscess developed under his own observation. In the case of a female child at the New York Infant Asylum both glands were entirely destroyed.

**Treatment.**—As soon as pus is discovered the abscess should be incised and drained, with a view to saving as much of the gland as possible. Of course, this advice applies particularly to a female patient. Wet dressings are not applicable in cases of young infants when the parts covering the thorax or abdomen are involved. It is good custom to protect the skin from infection by the use of a 25 per cent. boric acid ointment in cold cream as a base. This should be applied on old linen about the abscess opening. The dressing should be changed three times daily.

## TETANUS NEONATORUM

Tetanus is an acute infectious disease caused by the tetanus bacillus, an organism having its natural habitat in garden soil or dung heaps. Its point of entrance into the human body may be a lacerated wound, a mere abrasion, or, as is the case in tetanus neonatorum, the umbilicus. The local reaction may be very slight or attended by suppuration.

Tetanus is extremely rare in our hospitals and institutions for children because of the care exercised in treating the umbilical wound. Wherever gross uncleanness prevails, tetanus neonatorum will be found. It is particularly prevalent among savage and half-civilized races.

**Specific Cause.**—The tetanus bacillus is a slender, slightly mobile organism, positive to Gram's stain, growing only anaerobically, and developing a round spore characteristically placed at one end of the rod, giving it a nail or drumstick form. It was described by Nicolaier in 1885, and cultivated four years later by Kitasato.

The bacilli remain localized at the seat of infection, whence their toxins are carried along the axis-cylinders of the motor nerves to the motor cells of the spinal cord, pons varolii, medulla oblongata, and, to a lesser degree, the brain cortex. The localized spasms characteristic of the disease are due to the action of the tetanus toxin on the ganglion cells.

**Incubation.**—From the second to the ninth day is the usual period for the development of the disease, although it may appear as late as the fifth or sixth week. The period of incubation of the tetanus bacillus in man is probably of wide variation. The disease may appear immediately after birth or be delayed for five or six weeks. Few cases, however, develop after the third week of life.

**Pathology.**—The lesions found at autopsy in infants dead of tetanus neonatorum are few and non-specific in character. Acute omphalitis is usually present. The thoracic and abdominal viscera do not show any abnormality. The meninges of the brain and spinal cord are congested, while small hemorrhages into the nerve substance are frequent. These are manifestly the result, and not the cause, of the tetanic spasms.

On microscopic examination degenerative changes in the nerve-cells of the gray matter of the spinal cord are noted, but these changes are in no way specific.

**Prognosis.**—Few cases recover. Holt reported one recovery. The mortality is high. Those writers who have seen much of the disease place the mortality at 95 to 98 per cent.

**Symptoms.**—The earliest symptom usually observed is difficulty in nursing. The child attempts to grasp the nipple and lets go suddenly and cries. Perhaps the infant will give a sudden start and cry as though in acute pain, which is doubtless the case. Examination of the patient will show well-marked trismus; the jaw is set; the jaw muscles are tense. Stiffening and relaxation of the muscles successively occur. As the case progresses the muscles of deglutition become involved, and swallowing is impossible. The lips are said to pucker in the position of whistling.

The temporary relaxations become shorter; there is a tonic spasm, and, at the slightest irritation, such as the dropping of a pencil or a sudden, awkward movement of an attendant, the muscle spasm increases until a marked permanent opisthotonos results. The temperature is usually high— $104^{\circ}$  to  $106^{\circ}$  F.; the pulse very rapid—180 to 200. Death is usually due to exhaustion. Spasm of the respiratory muscles is probably a factor.

**Treatment.**—The treatment consists in the use of antispasmodics—among which bromid and chloral are most frequently used. Large doses are necessary.

In Holt's recovery case 8 grains of sodium bromid were given every two hours.

The patient is to be kept very quiet. Food and drugs are administered through a tube.

**Tetanus Antitoxin.**—Tetanus antitoxic serum is made by inoculating a horse with tetanus toxin formed by the growth in bouillon of the tetanus bacillus. Its prophylactic use has been of far greater value than its curative effect, and in every case of possible tetanus infection a dose of 1500 units of the antitoxin should be injected subcutaneously near the wound. Repetition of the dose after the expiration of a week gives additional security.

In order to do good, after symptoms of tetanus have appeared, the antitoxin must be administered as early as possible. The New York City Board of Health advises giving the initial dose of 10,000 units intravenously, and, if possible, also into the spinal canal and into the sheath of the nerve of the affected part. These energetic measures should be followed by subcutaneous doses of 5000 to 10,000 units every six to twelve hours for four days. In more severe cases, or in those in which symptoms have been present for several days before the treatment was begun, the initial dose should be doubled. It is also recommended that the wound be treated with a solution of iodine and that large amounts of water be given for its diuretic effect, since tetanus toxin is eliminated by the kidneys.

#### OPHTHALMIA NEONATORUM—GONORRHEAL OPHTHALMIA

One of the commonest forms of sepsis occurring in the newborn is acute purulent conjunctivitis.

**Etiology.**—In almost all instances the infection is conveyed at parturition from a pre-existing vaginitis of the mother. Two-thirds of the cases of ophthalmia neonatorum are produced from gonorrheal vaginitis; one-third from simple catarrhal vaginitis.<sup>1</sup> In cases in which the gonococcus is absent from the discharge the pneumococcus, *Bacillus coli*, and other organisms may be found. Infection may be conveyed indirectly after birth by dressings or towels or even by the fingers of the obstetric nurse.

**Symptoms.**—The condition becomes evident between two and four days after birth; infection developing later is acquired postpartum. The conjunctiva becomes red and swollen and is bathed in a secretion at first serosanguineous, then seropurulent, and ultimately purulent. The swelling and chemosis diminish during the stage of profuse purulent discharge which lasts two to three weeks and then gives way to a chronic inflammation with thickening of the conjunctiva which ordinarily persists for several weeks longer. Exceptionally this final stage is shortened. In four-fifths of the cases the disease is bilateral.

**Complications.**—Corneal infiltration with ulcer formation is frequent. Perforation of an ulcer may be followed by staphylocoma and even panophthalmitis.

**Prognosis.**—Under early and efficient treatment the prognosis is fairly good, depending on the virulence of the infection and the degree of corneal involvement.

**Treatment.**—*Prophylaxis* by the Credé method has become general and in advanced communities is almost universally compulsory. The method consists in immediate cleansing of the infant's eyes at birth, followed by the instillation of a drop of 2 per cent. silver nitrate solution. "A 1 per cent. solution of silver nitrate may be substituted, but 25 per cent. argyrol or 10 per cent. protargol are not so reliable."<sup>2</sup>

*Treatment of the developed disease* consists in the application of an eye shield to the unaffected eye (if one has escaped), and in the use of iced compresses and cool boric acid irrigations until tension and redness have abated. In the event of corneal involvement hot applications are to be substituted. During the later stages daily applications of 1 per cent. silver nitrate solution to the everted lids are recommended.

It is a safe rule to treat all cases of purulent conjunctivitis in infancy as if they belonged to the gonorrheal type. Too great care cannot be taken by physicians and nurses in the handling of these cases to prevent spread of the discharge by contaminated articles, and a safe rule is for all engaged in caring for such patients to wear glasses as a protection from spurting pus droplets and contaminated fingers.

## ICTERUS NEONATORUM

The theories relating to icterus neonatorum are most ingenious, but as all, or most all, are based on speculation, they are, as a result, most unsatisfactory. In fact, only very recently has there been much experimental work along this line.

As Stadelmann stated years ago, "Without a liver, no icterus," so

<sup>1</sup> May, *Diseases of the Eye*, 10th ed., p. 108.

<sup>2</sup> *Ibid.*, p. 109.

it is true today that theories excluding the liver as a participant are valueless. The forms of icterus in which biliary acids are demonstrated in the urine must be attributed to the resorption of bile in the liver. In icterus neonatorum the presence of biliary acids has been clearly demonstrated not only in the urine (Holberstein), but also in the pericardial fluid (Hofmeister). In view of these facts it is apparent that the liver must play the all-important part in the production of icterus because it is certain that the jaundice cannot be explained by hyperemia or capillary hemorrhage. The so-called hematogenous jaundice deserves more consideration in the light of recent experiments.

Such explanations as that of Franck, assuming a plugging of the ductus choledochus by means of mucus and cast-off epithelium, have been disproved. Of no further moment is the theory of Birch-Hirschfeld, who assumed an edema of Glisson's capsule; none of these assumptions has been verified by other observers. By anatomic examinations of the liver Bouchut's hypothesis of a hepatitis, and Epstein's theory of a catarrh of all ducts of the liver, have been demolished.

To the hematogenic factor, which has been strongly supported by Hofmeister, Stadelmann, and others, one must give more than a passing thought. These authors assumed that, as a result of the countless destruction of erythrocytes during the first days after birth, a polycholia resulted. This supposition of red-cell destruction has been refuted, the cause for the apparent destruction being attributed to increase in the blood-plasma. Heiman<sup>1</sup> supported the blood destruction theory, stating that an actual destruction of erythrocytes does occur. Assuming this later observation to be correct, one can readily see how with this destruction there is liberation of hemoglobin, which is taken up by the liver and transformed into bile pigments. It is further apparent that when bile is thus produced in excess and is taken up rapidly by the liver in large amounts, the bile capillaries are overtaxed and the bile cannot be rapidly removed, but is reabsorbed into the blood, whereupon choluria develops. If this excessive production of hemoglobin increases over certain limits, the "threshold of the kidney" is reached and the hemoglobin is excreted through the kidneys, thus producing a hemoglobinuria.<sup>2</sup>

The theory today, which, according to Finkelstein<sup>3</sup> probably finds greatest acceptance, is that of Quincke. This author considers a patency of the ductus venosus to be the deciding factor; by a persistency of the lumen of this duct the bile passes directly from the meconium in the intestine to the portal vein, and, circumventing the liver, enters the inferior vena cava, thus producing the icterus. In the light of more recent research, however, this duct has been found open as late as the fourth week of life; thus if this anatomic fact be considered a criterion, we would not be led to believe that icterus was produced by the patency of the ductus venosus, for if such were the case, icterus would be a phenomenon not of the first week, but of the first month of life.

According to Hess's observation with the duodenal catheter, bile is excreted into the intestine rarely during the first twelve hours of life,

<sup>1</sup> Zeitschr. f. Geburtsh. u. Gynäk., 1912.

<sup>2</sup> Pearce, Austin, and Eisenberg, Jour. Exp. Med., 1912.

<sup>3</sup> Lehrbuch d. Säuglingskrankh., 1905.

and is variable during the subsequent twenty-four hours, but in every one of his cases was profuse in *icterus neonatorum*. In many of his cases of marked jaundice the secretion was so profuse as to overflow into the stomach—a fact demonstrated by the introduction of the stomach-tube. Although Hess stated that the cause of this condition is not at present definitely proved, if one follows the principles of the physiology of the secretion of bile, one can assume, what seems to be probable, that the *icterus* is due to an increased amount of available hemoglobin; further, that some bile salts are taken up from the intestine, resulting in this disintegration of blood cells and a consequent increase of bile. Approaching the matter from another view, one can readily assume that the diminutive excretory mechanism of the liver at this stage is unable to cope with this excess of bile which Hess has demonstrated, and that a congestion of the bile capillaries ensues, as is shown by histologic examinations, and *icterus* results.

**Symptoms.**—Probably 75 per cent. of all newborn infants show more or less *icterus* a few days after birth. The degree of jaundice varies greatly. In comparatively a small proportion of the cases the conjunctiva becomes deeply involved.

Infants showing marked jaundice may lose in weight as a result of this condition. The jaundice rarely persists longer than two weeks, and such a duration is seen only in the severe cases. In the majority of the cases the skin is clear in a week after the onset. The urine is usually free from bile pigment. The stools are normal throughout the period.

**Treatment** is not required.

### CONGENITAL ABSENCE OF THE BILE-DUCTS

This malformation is of very rare occurrence. The first symptom, a rapidly developing jaundice, appears not later than the third day after birth. The jaundice increases rapidly, and in a few days is intense. In a case seen at the fifth month the skin was of a deep, greenish-yellow color, the conjunctiva was deep yellow, and the mucous membranes of the lips and buccal cavity were involved in the discoloration. In all cases after the passage of the meconium the stools become clay colored and so remain. The urine is of a deep brown color. The liver is always enlarged.

Death usually results from inanition before the third month. In one case the child died at the ninth month. In two cases the common duct was represented by a fibrous cord; in another there was an entire absence of the common duct. An abnormality of the bile-ducts should always be thought of in cases of prolonged *icterus neonatorum*.

Holmes<sup>1</sup> made an extensive review of the literature covering over 100 cases, with 89 diagrammatic representations of the different deformities. These diagrams show a wide range of deformities.

**Diagnosis.**—In *icterus neonatorum* of the familiar type bile is never absent from the stools, even though there is a marked degree of jaundice, and the skin begins to clear in the second week. A continuation of the jaundice without abatement after this time is suggestive of con-

<sup>1</sup> Amer. Jour. Dis. Child., vol. xi, No. 6.

genital obstruction of the ducts, and an examination of the stools determines the condition.

### HEMORRHAGIC DISEASES OF THE NEWBORN

In 1861 von Hecker and Buhl described a series of cases, under the title of "*Acute Fett-Degeneration der Neugeborenen*," that presented a somewhat similar picture without evidence of either syphilis or navel sepsis. Since that time this condition has been commonly called *Buhl's disease*. In the original article it was noted that most of the children were born in asphyxia. These cases showed the typical symptoms of the disease, and at autopsy all the viscera showed multiple hemorrhages as large as pinheads or larger, together with fatty changes that may be extensive. The authors did not attempt to explain the etiology, but considered that the condition was not due to navel infection and that it was not a manifestation of hemophilia because the ratio of males to females is not maintained as in hemophilia. In conclusion they said: "It is hardly necessary to state that one here has to do with a disturbance of metabolism manifested over the whole body, in which the changes in single organs are only a partial expression of the whole disease. This disturbance is evidently inborn, acquired in the last days before birth."

In 1879 Winckel tried to establish an entity distinct from the so-called Buhl's disease by describing a series of cases that manifested a slightly different clinical and pathologic picture. He considered this condition distinct from Buhl's disease, chiefly because it seemed to be epidemic in character and because the hemorrhages were more and the fatty changes less prominent than in the disorder described by Buhl. Winckel recognized the similarity of this condition to that of intoxication by phosphorus, arsenic, and potassium chlorate, and he ruled out, by careful histories and by chemical examination of the viscera, any possible participation of these drugs in the etiology of his cases.

In more recent times the Germans, in particular, have come to regard as Buhl's disease any condition affecting the newborn, that produces a severe icterus and fatty infiltration without evidence of infection; whereas any similar condition, of which the chief features are icterus and hemoglobinuria, has been looked upon as *Winckel's disease*.

These two classifications, however, have failed to suffice for all the hemorrhagic icteric conditions of the newborn infant.

Various other names have sprung into rather general use, and have served to complicate the nomenclature by adding terms based solely on clinical and morbid anatomic differences.

*Melæna neonatorum* is a term that has been applied to conditions in which hemorrhage has occurred from the gastro-intestinal tract, without necessarily any clinical evidence of hemorrhage elsewhere. Since 1829, when Cruveilhier found ulcers in the stomach of an infant who presented evidence of true melæna, many others have recorded the presence of such lesions with the result that a gastric or intestinal ulcer is usually considered to be the source of the hemorrhage in these conditions.

*Syphilis*.—These hemorrhagic conditions have frequently been found associated with congenital syphilis. There are hemorrhages, cyanosis,

edema, icterus, etc., but in many cases evidence of syphilis is wanting. Cases of Buhl's disease have been recorded by Furstenburg as occurring spontaneously even in the offspring of domestic animals, where presumably the presence of syphilis may be safely excluded.

*Bacteria.*—The rôle of bacteria has received the greatest consideration for the following reasons:

1. The close similarity between these conditions and the picture produced by navel sepsis.
2. The epidemicity of at least one group (Winckel's).
3. The finding of organisms at autopsy.
4. The experimental production in animals of certain of these conditions by inoculation with bacteria.

The belief is now almost universally held that many different bacteria may produce these diseases, because of the variety of micro-organisms that has been found at autopsy (staphylococci, streptococci, Gärtner's bacillus, *Bacillus pyocyaneus*, *B. coli*, and various other types). The inoculation of animals with many of these organisms has frequently been followed by the production of diseases similar to those in human beings. In certain cases, at autopsy, lesions indicative of an infectious process, as, for example, hyperplasia of intestinal lymphatic tissue, have been found, but, on the other hand, such findings are frequently absent, and it is very striking that in many cases there seems to be very insufficient evidence that infection has played an important rôle.

In general one may conclude that there is strong evidence favoring the idea that many cases are caused by infections, and, on the contrary, insufficient evidence for assuming that all are due to infections.

*Mechanical Causes.*—Mechanical factors, such as trauma, thrombosis, embolism (Landau), deserve only mention, as they have been found only very occasionally (Thomson).

*Heredity.*—The possible importance of hereditary influences was considered by von Hecker and Buhl when they stated that the disease was evidently inborn, and acquired during the last few days of pregnancy. The relation of heredity to true hemophilia requires no present mention.

There are certain affections of the adult, at present of unknown etiology, which, if transmitted to the fetus, might cause their various syndromes in the newborn. Reference is made particularly to the closely related conditions of acute yellow atrophy, of eclampsia, and of certain septicemic conditions. Numerous observations are on record describing the pathologic changes in the offspring of eclamptic mothers, and it is particularly interesting that in general the abnormal features correspond closely with the icteric and hemorrhagic syndromes of the newborn.

Each report summarizes the pathologic changes as thrombosis and parenchymatous degeneration, fatty degeneration or necrosis, especially in the liver and kidneys, hemorrhages in the organs, and subphrenal, subpericardial, and subendocardial extravasations of blood.

*Chemical Agents.*—Finally, intoxication by known chemical agents occasions symptoms and pathologic changes similar to the disease in question. Among this long list of agents may be mentioned phosphorus, arsenic, potassium chlorate, and chloroform. That there are many

features of these conditions that suggest a common general process has already been emphasized by Knopfmacher.

*Metabolic Changes.*—The symptoms and gross changes are suggestive of poisoning by the above-mentioned agents, but they also occur in conditions of obscure etiology, such as acute yellow atrophy, eclampsia, and cyclic vomiting of children. All the chief features that characterize this latter group, including certain metabolic phenomena, such as appearance of lactic acid and sugar in the urine, not to mention others, are known to occur also after respiration of rarefied air or after asphyxia from any cause, that is to say, from lack of oxygen. In phosphorus-poisoning there is a deficiency of available oxygen. Chloroform does not belong to this group, producing deficient oxidation of the tissues; but it would seem, *a priori*, that there was some evidence to suggest the existence of a causal relationship between chloroform used at labor and the occurrence of some of these various conditions of the newborn.

Evarts Graham (Chicago) concluded, after a careful experimental study and review of the literature, of which the preceding paragraphs are a résumé, that the conditions of the newborn characterized by a hemorrhagic tendency, icterus, and fatty changes, are probably all syndromes which may occur as the result of a number of toxic agents. He produced experimentally the essential features of the disease group by the administration of chloroform to the point of asphyxia.

Duke believed that the bleeding is due to a deficiency in the number of platelets in the blood, and thus absence of thrombin formation, which is essential in order to produce clotting. In some cases the coagulation time is normal, in others, abnormal.

Gelston<sup>1</sup> has reported a case of hemorrhage in a newborn male infant treated by whole blood injections in which it was possible to demonstrate at the time of the hemorrhage a practical lack of prothrombin, while within eight hours after the cessation of the hemorrhage prothrombin was present in normal quantities. The loss of prothrombin-antithrombin balance is considered to be a direct factor in the etiology of such diseases. Gelston concluded:

"Several possibilities present themselves. There may be simply a stimulation to the production of prothrombin; the injection may supply enough prothrombin to cause cessation of the bleeding, although not fully re-establishing the balance, or it may actually re-establish the balance. The latter seems hardly logical, considering the small amounts of whole blood necessary. It is more probable that a combination of the first two possibilities is involved, with a stimulation to the production of prothrombin and the addition of a sufficient quantity in itself to bring the constituents just within the margin compatible with approximately normal function."

Rodda<sup>2</sup> found that the incidence of true hemorrhage neonatorum, which is accompanied by delayed coagulation and prolonged bleeding time, conformed closely to the prolonged coagulation and bleeding time observed for normal infants between the first and fifth days of life.

<sup>1</sup> C. F. Gelston, *Etiology of Hemorrhagic Diseases in the Newborn*, Amer. Jour. Dis. Child., vol. xxii, p. 351.

<sup>2</sup> Jour. Amer. Med. Assoc., August 14, 1920.

Cerebral hemorrhage was found in over 50 per cent. of all infants who died intrapartum or during the first days of life.

A considerable number of these cases have come under our observation. Repeatedly hemorrhages from the newborn have been observed to occur in the internal organs and from various portions of the body. A colored infant at the New York Nursery and Child's Hospital bled to death in the pericranial tissues without a sign of hemorrhage elsewhere. At this institution there was at the same time during the senior author's service a small epidemic of fatal hemorrhages in the newborn. The colored child referred to was the only one in which the hemorrhages were not multiple. Some cases were due to proved sepsis; in others there was no demonstrable lesion of the blood or vascular apparatus. In one infant the hemorrhages began on the third day subcutaneously on the dorsum of the foot and rapidly extended until the child bled to death in her own tissue.

At this time we were not aware of the usefulness of human blood in these cases. In just such cases the results from human blood treatment referred to below are most promising.

**Treatment.**—The use of styptics and astringents for controlling the hemorrhage is useless. The only local measure that has assisted in any way has been the application of pressure to the bleeding parts, and this is not possible in many situations. Adrenalin, locally or by internal administration, has not been of any appreciable service.

*Illustrative Case.*—One of the most important contributions to the literature of hemorrhage in the newborn was presented in the Medical Record of May 30, 1909, by Dr. Samuel W. Lambert, of New York City. In his case a direct transfusion of blood from the father to the child was successful in stopping the hemorrhage when the case was almost hopeless.

The only general treatment worth considering is the use of human blood, administered by transfusion or injected intramuscularly.

During the past few years many cases of hemorrhage in the newborn have been treated by the use of human whole blood injections. The blood is readily drawn from the basilic vein of the donor and injected into the buttocks of the patient. This is the most rapid method. No tests are required for hemolysis and agglutination. One ounce of blood was used in each of 3 of the writer's cases, completely controlling the hemorrhage.

When subcutaneous injections of blood prove ineffective immediate transfusion is indicated. Typing of the blood of both the infant and the donor should be done when possible in all transfusion cases.

## VII. DISEASES OF THE MOUTH AND ESOPHAGUS

### STOMATITIS

THE term *stomatitis* is applied to an inflammation of the mucous membrane of the mouth. Three types are usually described by pediatric authors—the *catarrhal*, the *aphthous*, and the *ulcerative*.

A specific type in which throat symptoms are usually pronounced, known as Vincent's angina, is described on p. 319.

There are many cases of catarrhal stomatitis which, under treatment, go no further; other cases, with or without treatment, go on to the development of aphthæ, or an ulcerative condition. Both conditions may be combined. Many cases, when they appear for treatment, have the so-called aphthous spots already developed, but the condition described as "catarrhal stomatitis" also is present. Other cases when they come to us show marked ulceration, but never without catarrhal symptoms.

**Bacteriology.**—Catarrhal, aphthous, and ulcerative stomatitis have no established specific bacteriologic etiology.

**Etiology.**—The cause of the disease is unquestionably an infection, and there is no doubt that it is contagious. As to the nature of the infection positively nothing is known. The combined action of several varieties of micro-organisms is the most plausible explanation. Stomatitis has been observed to go through an entire family of several children. Authors are prone to attribute the trouble primarily to mechanical irritation, such as careless manipulation during the mouth toilet; but the majority of children when they applied for treatment had never been accustomed to mouth toilets of any kind. The giving of overheated food is supposed by some to be a causative agent. If this were the case, 75 per cent. of the infants among the poorer classes would never be free from the disease. The food of bottle-fed children unless carefully watched is almost invariably given too hot. The disease, however, is not limited to dispensary patients. We have seen many cases among the well-to-do. Where gross uncleanness is the family habit, the number of cases of stomatitis will, for obvious reasons, be greater; there are more bacteria to carry infection. Children whose mouths are carefully cleaned after each feeding do not develop stomatitis. To teach that a child's mouth should not be washed because an indifferent doctor may fail to instruct the mother or nurse as to how it should be done is rank heresy. When errors of the mother or nurse occur in performing the various offices for the child, it is our observation that, nine times out of ten, the fault is due to lack of instruction by the physician. The mouth may be very effectually cleansed without injuring the mucous membrane in the slightest degree.

**Symptoms.**—The first symptom of a stomatitis is a superficial catarrhal inflammation of the mucous membrane of the mouth characterized by redness and injection of the gums. If "aphthæ" develop, small grayish plaques appear on the mucous surface of any portion of the buccal

cavity. In mild cases there may be but three or four areas. In a case of moderate severity the mucous membrane of the gums, the hard and soft palate, and the inner side of the cheek will be studded with ulcerated, grayish-white areas, varying in size from a pinhead to a split pea. Occasionally the areas coalesce, forming larger plaques of a serpiginous type.

Ulceration, which ordinarily does not appear until after the catarrhal condition has been present for at least three or four days, will first be noticed as a faint yellow line at the margin of the gum where it joins the teeth. This is the commencement of what Virchow describes as "necrobiosis." Ulceration never occurs unless teeth are present. We have never known a case to go on to ulceration in a baby fed entirely at the breast. Whether the case remains simply catarrhal, or whether aphthæ or ulceration, or both result, certain symptoms are common to all. There is a marked increase in the flow of saliva, which in some cases may be said to stream from the mouth, running down over the chin and soiling the clothes. On account of its acid properties it causes irritation of the skin and even eczema. The mouth is hot and painful. Fever is present in a slight degree both when the condition is simply catarrhal and when aphthæ are present. There is but little prostration and the child appears but slightly indisposed. In cases which go on to ulceration the fever may be very high, frequently 104° F. or over. In one case it reached 107° F., although no cause except the ulcerative stomatitis could be found for the fever. Under properly directed treatment this child recovered in a few days.

On account of the pain occasioned by drawing on the nipple nutrition may be considerably interfered with. The child takes the breast or bottle greedily, draws a few times, stops, and begins to cry. If he is urged to try again, the behavior is repeated. The pain appears to be particularly severe when aphthæ are present. The advent of ulceration will be indicated by a change in the breath, which becomes disgustingly foul. The gums are thick, spongy, and bleed easily, and in some cases overlap the teeth very early in the ulcerative stage. If a case has been neglected or improperly treated, which is the history of not a few dispensary patients, the ulceration is often so extensive that the teeth become loose as a result of the destruction of the gum, and their removal is necessary. Strong, vigorous children seem as susceptible to the disease as are the rachitic, the badly fed, or the generally delicate.

**Prognosis.**—The prognosis is good. All cases recover if seen early and if properly treated. Loss of teeth may result in those seen when the process is well advanced.

**Treatment.**—*Mouth Washing.*—When the stomatitis is catarrhal or aphthous, preventive treatment—the washing of the mouth after each feeding with a saturated solution of boric acid in boiled water—is also curative. A baby's mouth should be washed as follows: The child is placed on the side or stomach. The index-finger of the mother or nurse thoroughly wrapped in absorbent cotton is then dipped into the solution, and without expressing the fluid, is placed in the child's mouth. By gentle pressure upon the gums and cheeks a sufficient amount of the fluid is then expressed to run out of the mouth and effectively cleanse it.

The washing is assisted by the opposition offered by the child to the manipulation of the tongue, cheeks, and jaws.

*Drugs.*—Internal medication is of no value except indirectly. If there is a disordered digestive state, it should receive attention by diet and saline laxatives. Calomel should not be given. Whether the condition is catarrhal or aphthous, it is practically never necessary to use other means than the free mouth washing. Astringents and caustics have never been necessary.

The cases usually terminate in recovery in from four to seven days under strict attention to cleanliness as regards the feeding apparatus or the mother's nipple, together with the free use of the boric acid solution as a mouth wash.

*Feeding.*—The food problem is difficult to deal with, particularly in the case of nurslings, on account of the pain caused by drawing on the nipple, the child refusing absolutely to nurse. In some cases it may be necessary to draw the milk with a breast-pump, and for a day or two feed the baby with a spoon. With the bottle fed spoon feeding may also be resorted to. The child will take the nourishment much better if it is given cool. Small pieces of ice and teaspoonful doses of cold water are taken eagerly.

**Treatment After Ulceration.**—With the development of ulceration a change in the management is necessary, both as regards a mouth wash and the necessity for internal medication. Among the local measures hydrogen peroxid as a mouth wash, 1 part of a 3 per cent. solution in 2 parts of water, used after each feeding, has given the best results. Such means, however, are rarely necessary if the case is seen early. Except in cases that show a considerable destruction of tissue no other means to secure cleanliness than the boric acid solution is required.

*Chlorate of Potash.*—In the internal administration of chlorate of potash we have what is practically a specific in this disease. Its administration should be commenced as soon as the condition is recognized. One may prescribe the drug conveniently in syrup of raspberry, using 1 part of syrup to 2 parts of water. For a child under eighteen months of age one may order 2 grains at intervals of two or three hours—not more than 10 grains in twenty-four hours; for a child from eighteen months to three years of age 2 or 3 grains at the same intervals, not more than 15 grains in twenty-four hours. With the above dosage it will be necessary, in the average case to continue the drug from three to five days. Very often, after the improvement is well marked, we reduce the dose one-half and continue it for three or four days longer.

*Dangers of Chlorate of Potash.*—Much has been written concerning the danger of the internal use of chlorate of potash in children, particularly in relation to its effects upon the kidneys. If the use of the drug in suitable doses were of special danger in this respect, the free use of the chlorate of potash and iron mixture, so extensively prescribed in diphtheria in the pre-antitoxin period, would have been universally condemned. We have never seen any unpleasant effects from chlorate of potash given in doses of 10 to 20 grains daily, and we have used it in many hundreds of cases of acute inflammatory conditions of the throat and mouth.

## SPRUE (THRUSH; MYCOTIC STOMATITIS)

The disease makes its appearance in the form of small white masses of about the size of a pinhead. The tongue and the inner sides of the cheeks are favorite sites for the growth, although in severe cases the entire buccal cavity may be studded, as though finely curdled milk had been scattered over the surface, and the lesions may extend into the stomach. The growth is firmly adherent, and its forcible removal produces slight bleeding.

**Etiology.**—Sprue is invariably associated with uncleanness, and occurs, as a rule, in weakly and marasmic nurslings and in the bottle fed—more frequently in the latter. The disease is rarely seen after the sixth month.

Thrush, soor, or mycotic stomatitis is due to *Oidium albicans*, an organism which stands between the yeasts and the fungi. The threads of the mycelium end in egg-shaped conidia which bud and form new hyphæ. Spores are formed only under favorable cultural conditions. Preparations made from the white patches on the buccal mucosa show both mycelia and yeast-like conidia.

**Symptoms.**—An infant with this disease gives evidence of much pain and discomfort while nursing or while feeding from the bottle. Active gastro-enteric disturbances, such as vomiting and diarrhea, may be associated with sprue, but such association is not the rule. Time and again one sees cases in which there are absolutely no other signs of the disease than the characteristic mouth lesions and the patient's refusal of food. The average case may easily be cured in a week if treatment is carefully carried out. Sprue is not contagious, and if the means of prophylaxis, which will be suggested, are used as a part of the daily routine the disease will never appear.

**Treatment.**—If the patient is breast fed, the mother's nipples must be washed with a saturated solution of boric acid and moistened with alcohol, diluted one-half, which is allowed to evaporate before each nursing. If the infant is bottle fed, both nipple and bottle should be boiled after each nursing, and the nipples turned inside out and scrubbed with borax water—1 ounce of borax to 1 pint of water. In either case the mouth should be washed with a saturated solution of boric acid after each feeding. For this purpose a generous amount of absorbent cotton loosely wrapped around the clean index-finger of the mother or nurse is placed in the cold solution, and then, without expression of the water, introduced by the finger into the child's mouth. In the care of fully developed sprue, the application should be brought gently into contact with the diseased parts, first on one side and then on the other, and finally pressed over the tongue and under the tongue. It is well to have the child rest on the side or abdomen so that the fluid which is pressed out by the manipulation of the cotton against the cheek and jaws can readily escape from the mouth. The washing, which really amounts to an irrigation, can be done in a few seconds, without the slightest danger of abrading the epithelium. In obstinate cases this treatment may be supplemented by penciling once a day with 1 per cent. solution of formalin.

Internal medication is of no value except as a means of correcting

any intestinal derangement that may exist, with a view to improving the general condition. If the bottle or breast is refused, spoon feeding, for a few days, may be found necessary, and in any event will hasten the cure. If the child is nursed, the mother's milk may be drawn with a breast-pump (see p. 54) or pressed out with the fingers and then fed by the spoon. The domestic remedy, honey and borax, should not be used in treating any of the inflammatory diseases of the mouth in children.

### CANCERUM ORIS (NOMA)

**Etiology.**—No single micro-organism has been proved to be the cause of noma. Spirilla and fusiform bacilli have been found (Weaver and Tunnicliff) not only in the necrotic tissue, but in the surrounding healthy parts. Whether these organisms represent the primary cause of the lesion or only secondary invaders is not known. In other instances *Bacillus diphtheriæ* has alone been found. The nature of the lesion points to the action of a specific infection. Measles and diphtheria are at times precursors of noma.

**Symptoms.**—The site of the disease is usually the inner side of one or both cheeks. The gangrenous process usually begins as a small, inflamed, infiltrated area in the mucous membrane opposite the teeth. Localized destruction of tissue follows, and this process extends with great rapidity until the tissue sloughs away in masses. The parts for some distance around the ulcer become hard, infiltrated, and discolored, presenting an inflamed, edematous look. After two or three days a discolored, ecchymosis-like area may be noticed on the outer side of the cheek, corresponding in location to the gangrenous portion within. At this point the ulcer soon perforates. The destruction of tissue continues quite symmetrically around the ulcer until the whole cheek is destroyed. The process not infrequently involves the bony structure, causing necrosis of the jaw, with loosening and falling out of the teeth. A symptom which will never fail and can never be forgotten by one who has seen even one of these cases is the almost unbearable stench which emanates from the patient. When the hands or the fingers of the physician or nurse come in contact with the gangrenous slough, it is almost impossible to remove or neutralize the disgusting odor. The disease usually occurs in weakly, marantic children, who die, ordinarily, from exhaustion and sepsis within ten days or two weeks from the onset of the disease. Hemorrhage is rarely a complication. The disease is usually fatal, even under the best management.

**Treatment.**—The treatment pursued has consisted in the use of free cauterization with nitric acid, chemically pure, and the application of disinfectant wet dressings of bichlorid 1 : 2000, saturated solution of boric acid, or equal parts of alcohol and water. The dilute alcohol is apparently more effective in staying the progress of the disease than is either the bichlorid or the boric acid solution. On account of its rapid evaporation the alcohol should be applied on two or three layers of lint and covered with rubber tissue. Even then frequent renewals are required. Hydrogen dioxid may be used to cleanse the ulcer both before and after perforation.

## FISSURES OF THE LIPS

Deep cracks and fissures in the lips are of quite frequent occurrence among children. Usually the lower lip is involved, and in many of the cases there is but one deep fissure and that at about the middle of the lower lip. Marasmic, ill-conditioned children are the most frequent sufferers. The fissures bleed easily and occasion considerable pain during nursing. As a result less food is taken than the child requires.

**Treatment.**—If the fissure is deep, a 50 per cent. solution of nitrate of silver should be applied at the commencement of the treatment. This is to be followed by frequent applications—three or four times daily—of a 25 per cent. solution of ichthyol. Healing is usually prompt, requiring but a few days. If the mucous membrane of the lip generally is dry and fissured, as in cases of prolonged illness with fever, the frequent use of a 5 per cent. boric acid ointment, made with cold cream as a base, will be of material assistance in controlling the condition.

## ULCERATIONS AND FISSURES AT THE ANGLE OF THE MOUTH

Ulcerations and fissures at the angle of the mouth are by no means uncommon in delicate and marasmic infants. While ulceration in this location is one of the manifestations of congenital syphilis, such ulcers are not necessarily syphilitic. The condition, however, is of sufficient importance to require treatment, because the affection is so painful as to prevent the taking of adequate nourishment. Painting the fissure with a 25 per cent. solution of ichthyol every three hours during the day will insure prompt healing.

## GEOGRAPHIC TONGUE

The condition known as a "geographic tongue" consists of distinct, smooth, reddish patches on the tongue's surface, surrounded by a light grayish, narrow, raised border. The smooth surfaces comprising the involved areas are devoid of epithelium; the borders are composed of hypertrophied papillæ which take on a grayish color, making a distinct framework for the reddish areas, which are almost always crescentic in shape. This peculiar marking has given rise to the term "ringworm of the tongue." Geographic tongue is seen most frequently in children under three years of age, and occurs as often among the strong and vigorous as among the delicate and weakly. The condition is usually discovered by the mother, who, with much agitation, brings the child to the physician. It does not appear to be due to and is usually not associated with any disturbance of the gastro-enteric tract. That portion of the tongue which is not involved appears perfectly normal.

**Treatment** of geographic tongue is unnecessary, as the condition causes no symptoms and apparently is independent of any disease. It is a good custom to assure mothers that the condition is of no consequence, for it usually disappears in a few months. One case was observed to last for a year.

## DIFFICULT DENTITION

It is claimed that the eruption of the teeth is a physiologic process, and as such is not productive of harm. In normal, well babies this is generally the case. There may be a slight fever and restlessness, with loss of appetite, associated with the eruption of a tooth, but the disorder is usually very temporary in character. In delicate children, particularly in those who teethe late, as in the rachitic, when several teeth are cut at one time, not a little inconvenience may be caused by dentition. Even these patients, however, rarely have grave digestive disorders. In a large experience with teething infants we have known barely one in whose case convulsions were apparently directly dependent upon dentition. Such an exceptional patient was a rachitic, institution child who cut his first tooth at the ninth month, and with each of the three succeeding teeth, which were cut during the next three months, developed convulsions without any other signs of illness.

Temporary digestive disorders are of very frequent occurrence in this type of child during an active dentition. The child may be restless and irritable and perhaps have fever of a degree or two. His digestive capacity is lessened, and if the usual diet is continued, fermentative diarrhea results, which may be, and often is, the starting-point of grave intestinal disease. When it is apparent that the child's generally good natured, daily habit of life is being unfavorably influenced by dentition, the food should temporarily be reduced, particularly if the weather is hot.

Breast babies may be given water before each nursing so as to reduce the capacity for milk. For the bottle fed 2 or 3 ounces of the food mixture may be removed from each bottle, the amount being replaced with boiled water.

That cough and respiratory and skin diseases are immediate results of dentition is without foundation. During active dentition, when the gums are distended and swollen from pressure, relief will often be furnished promptly by rubbing through the prominent points of the tooth with a clean towel over the index-finger. Lancing alone may be performed, but unless the tooth is well advanced it is quite possible that the gums will reunite over the tooth, forming a cicatrix which will make the eruption more difficult than before. If a week or ten days' discomfort can be obviated by assisting a tooth through the gum, we fail to see any contraindication to such a procedure.

## DISEASED TEETH

The influence of diseased teeth upon the proper mastication of the food and indirectly upon digestion and nutrition has long been recognized. During the past two decades the rôle of such teeth as potential foci for disseminating general infection has assumed an importance secondary only to that of diseased tonsils.

Many factors combine to promote faulty structure and early decay of the teeth. Defective calcium metabolism from whatever cause in the early years when enamel formation is active is perhaps a foremost causative factor. This is best exemplified in rickets. In syphilis the teeth are notoriously diagnostic of the disease. In typhoid and many of the

acute infectious diseases inroads upon the normal tooth structure are often marked, conforming closely to the bad effects on the nutrition of the body as a whole. When to such direct causes of tooth decay are added the factors of improper diet, poor heredity, malformation of the jaws and palate, adenoid obstruction, and lack of cleanliness of the mouth it is apparent why the demands made upon the dentist for therapy are often paramount to those made upon the physician.

The clinician should make the examination of the teeth a matter of routine, and in the absence of other disease foci in the body will do well to consider bad teeth as perhaps the salient etiologic factor underlying the following conditions: anorexia, bad breath, stomatitis, headache, unexplained temperature elevation, rheumatism, cervical adenitis, secondary anemia and malnutrition, faulty nervous control, chorea, and exceptionally even epilepsy. In all such cases the indications are obvious. The argument often advanced that diseased teeth of the first set require no dentistry because they will soon be replaced by a good second set is analogous to the reasoning of the dirty housekeeper who relaxes her energy completely in view of a remote moving day.

### HARELIP AND CLEFT-PALATE

Harelip is a vertical cleft in the upper lip resulting from arrested embryonic development. This defect may or may not be associated with cleft-palate, and varies from a slight indentation in the border of the lip to a deep fissure, which may be bilateral, extending into the nostril, complicated by non-union of the palate. In any case the deformity will be easily understood if we recall that the normal development of the face depends upon the union of the central or frontonasal process with the two lateral superior maxillary processes. Posteriorly, this union is completed in the median line of the palate, and anteriorly, on either side external to the incisors, in the soft parts beneath the nostril.

**Etiology.**—The malformation is more frequent in males than in females, and in some instances can be ascribed to heredity. Not infrequently with cleft-palate other congenital defects coexist. The true cause of the arrest in development is unknown.

**Varieties.**—Both harelip and cleft-palate may be complete or incomplete, unilateral or bilateral. When the harelip is double, cleft-palate also almost always exists. Median harelip is of exceptional occurrence.

**Symptoms.**—The character of these deformities is wholly apparent. In the simple forms of harelip the disadvantages may be merely cosmetic. When there is a cleft in the palate, however, suckling will be interfered with, deglutition will be difficult, and if the child goes untreated and survives, articulation will be imperfect.

**Treatment.**—The treatment of both harelip and cleft-palate is essentially surgical. The former defect, if uncomplicated, may usually be satisfactorily obliterated by an operation of the König or Nélaton type. Cleft-palate offers more serious obstacles. Brophy's operation secures an approximation of the edges of the cleft by the gradual tightening of silver wire sutures traversing two lead plates, each of which is fitted to the lateral portions of the alveolar arch. The operation on the

hard parts is deferred until the child is fourteen to eighteen months of age. When the cleft is small, this procedure may be excluded in favor of a more direct method. An operation during the first months of life involves considerable risk, but offers better possibilities for good development of the nasopharynx than an operation deferred until the third or fourth year, after the growth of the teeth. The appropriate course to adopt in any case should, therefore, be left to the surgeon.

In young infants with cleft-palate spoon feeding or gavage is frequently necessary. Good results in some cases are reported to have followed the use of a special nipple with a flange on either side, designed to bridge over the fissure in the palate.

### MALFORMATION OF THE ESOPHAGUS

Malformation of the esophagus is of infrequent occurrence, and when present is usually accompanied by other congenital deformities.

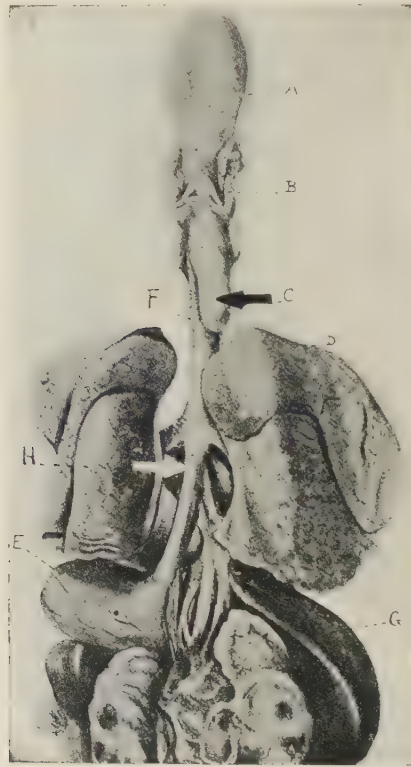


Fig. 21.—Atresia of the esophagus with esophagotracheal fistula. Anterior view. A, Tongue; B, larynx; C, blind esophageal pouch; D, lungs; E, stomach; F, trachea; G, liver; H, lower end of esophagus, which communicates with the trachea. (From a dissection by Losee.)

In most instances the differentiation of the esophagus from the trachea and bronchi, in the metamorphosis of the embryonic foregut, has been incomplete.

The list of possible abnormalities includes the following:

- (a) Total absence of the esophagus.
- (b) Diesophagus, involving partial or complete reduplication of the esophagus.
- (c) Esophagotracheal fistula, with or without obliteration of the lumen of the esophagus in a portion of its extent.
- (d) Division of the esophagus into upper and lower non-communicating pouches.
- (e) Congenital stenosis.
- (f) Congenital dilatation.

The symptoms caused by these conditions depend on the obstacles opposed to deglutition. Regurgitation of food and accumulated mucus is constant, accompanied by suffocative attacks due to the entrance of material into the respiratory tract. Congenital dilatation above the diaphragm may produce the symptom of rumination.

In a large majority of the cases congenital malformation of the esophagus results in death before the tenth day from asphyxia, aspiration pneumonia, or starvation.

Gastrostomy offers the only possible means of prolonging the patient's life till surgery directed at the primary defect can justifiably be attempted.

*Illustrative Cases.*—An autopsy on an infant a few days old referred to the Babies' Hospital showed that the trachea communicated with the esophagus just above the bifurcation.

The esophagus was normal at its upper portion, dilated lower down, and formed a blind diverticulum which ended below the level of the tracheal bifurcation. Above the diverticulum the esophagus communicated with the trachea through an opening in its anterior wall. Below the diverticulum the esophagus was smaller in caliber than normal, but it was pervious and communicated with the stomach. A probe could be passed upward through the esophagus into the larynx.

A baby seven days old took the bottle greedily and, after swallowing about 2 drams, regularly returned the milk through the nose. He would nurse vigorously with the milk streaming from the nose.

### ACQUIRED STRICTURE OF THE ESOPHAGUS

Practically all cases of this nature are the result of the swallowing of a corrosive poison. In one of our own patients carbolic acid was the cause. Chevalier Jackson has reported several cases due to commercial lye used for cleansing purposes, and warned strongly against the danger of leaving such substances carelessly in places accessible to children.<sup>1</sup>

<sup>1</sup> Jour. Amer. Med. Assoc., July 2, 1921.

## VIII. DISEASES OF THE STOMACH, INTESTINES, AND PERITONEUM

### THE STOMACH

**Anatomy.**—During fetal life the position of the stomach is almost vertical, at birth slightly oblique, the obliquity increasing with age. At birth the stomach is almost cylindric, and, according to Pfaundler, between the time of birth and the seventh month the fundus of the stomach increases to fully twice its original length, so that at about the end of infancy the stomach lies in a somewhat oblique position, passing from behind forward and downward. The diaphragm is penetrated by the esophagus at about the level of the ninth dorsal vertebra, while the cardia is about on a level with the tenth. The pylorus, though usually situated in the median line, may occasionally be found to the right of it.

**Capacity.**—The capacity of the infant's stomach is, even up to the present day, a subject of more or less speculation, due, no doubt, to the fact that during life aspirations are unreliable on account of the fact that food passes almost immediately into the duodenum, and methods of experiment on the cadaver require an amount of pressure (14 to 30 c.c. of water) that does not exist in the normal state during life. The stomach undergoes a systolic contraction after death, and thus the distention with fluids is artificial.

The absolute capacity, according to Holt, Rotch, Pfaundler, and Fleishmann, varies, depending on the method of examination employed. According to Holt's observations, based on postmortem examinations of 91 infants, the capacity at birth is  $1\frac{1}{2}$  ounces; at three months,  $4\frac{1}{2}$  ounces; at six months, 6 ounces; at twelve months, 9 ounces. This subject is discussed on page 38.

**Gastric Digestion.**—Digestion in the stomach is not so important in the infant as in the adult. The function of the infant's stomach is mainly that of a reservoir, the digestive processes being only preliminary. The principal change in the milk, so far as the stomach is concerned, occurs in connection with the casein curd, and up to the present time it is well established that protein digestion in the stomach does not go beyond the stage of peptone formation. Pepsin is found in large amounts in the infant's stomach, and, according to some observers, occurs as early as the fourth month of fetal life. The reaction of the stomach contents is usually acid inside of fifteen minutes after ingestion of food, but free hydrochloric acid is not present till thirty or forty-five minutes after, the reason being that hydrochloric acid combines with the casein and milk salts.

The coagulation of milk, which is the first change that it undergoes, is brought about through the agency of the rennet ferment. The casein coagulum of cow's and of human milk is essentially different, the former being a firm mass, containing in its meshes the fat of the milk, the latter being in fine flocculi, with little of the fat, and readily acted on by the

stomach juices. Due to the influence of pepsin and hydrochloric acid solution of the coagulum begins; this occurs more rapidly in woman's milk on account of the lower casein content and the small size of the curds. During the first half-hour the fluid portion or whey begins to leave the stomach, and at this time a considerable portion may be found in the intestine, and at the end of an hour in a young infant the stomach may often be found empty. In a bottle-fed baby the coagula are larger, solution is retarded, and consequently the food is retained longer. If the milk is boiled, solution is more rapid and gastric retention lessened.



Fig. 22.—Normal stomach of a newborn infant. Some of the opaque mixture has immediately passed through the pylorus and reached the jejunum (J).

Some observers believe a fat-splitting ferment to be present, but this, if present in the stomach, plays but a small rôle in digestion.

*Motility.*—The duration of digestion varies of necessity with the age of the infant and the composition of the food. In general terms it may be stated that in breast-fed infants digestion is completed in one and one-half to two hours; in artificially fed infants taking raw milk, in about one to two hours longer; and in those taking boiled milk, in a little less time.

Cannon demonstrated that an acid reaction of the contents of the pyloric portion causes the pylorus to open, while an acid reaction in the duodenum causes it to remain closed. After the coagulation of the casein

of the milk the whey is readily acidified and passes the pylorus first, together with the carbohydrates. As the protein requires a longer time to combine with the acid of the stomach it is some time before free acid is present, and the exit of the protein from the stomach is, therefore, delayed. The fatty acids and neutral fats are the last to pass the pylorus, because of the longer time required for the fatty acids to be neutralized by the duodenal secretions; and the pylorus, therefore, remains closed because of duodenal activity. The opening and closing of the pylorus, according to these investigations, depends chiefly on the reaction of the gastric contents, which is the most vital factor in the motor activity of the stomach.

### THE MANAGEMENT OF VOMITING BABIES

The baby who habitually vomits or regurgitates his food is one of the most troublesome patients with whom we have to deal.

In such cases the possibility of existing pyloric stenosis or of rumination must be excluded. Excellent results, in feeding these habitual vomiting children, have been gained by the use of cereal decoction and a fat-free milk. One ounce of barley flour to the pint of water is cooked for thirty minutes, and water added to make one pint at the completion of the boiling. The child is fed one-third skimmed milk to two-thirds barley water, or equal parts of skimmed milk and barley water, depending upon the patient's age and condition. Unless the child is very young the interval between feedings should be three hours or longer, and absolute quiet should be enforced for one and one-half hours after feeding. The handling and tossing about of the vomiting child is one of the best ways of keeping up the trouble. If constipation results from such a diet, magnesia in sufficient amount may be added to the daily ration.

It is not to be expected that a patient will grow on the above diet. When the vomiting is controlled, the food strength may be advanced by the use of whole milk, and later by the addition of milk-sugar. The addition of 20 grains of bicarbonate of soda to the day's ration is of decided benefit in very troublesome cases.

By some infants fresh cow's milk will not be tolerated, even in very weak dilution. In such instances we have been successful in using evaporated milk to which cane-sugar has not been added. From 1 dram to  $\frac{1}{2}$  ounce is added to the amount of barley water given at one feeding.

The more severe and persistent cases call for trial of the thick cereal feeding described on page 85. The remarkable effects of this mode of treatment in occasional cases can hardly be exaggerated, and the range of its application has been greatly widened in the past few years.

*Stomach Washing.*—Nearly all habitually vomiting infants will improve more rapidly if they have a stomach washing every day for a week, and every two or three days thereafter, as may be necessary. For vomiting in rumination see p. 206.

Additional consideration has been given the general subject of vomiting in infancy in a preceding chapter (p. 100).

## VOMITING OF OLDER CHILDREN

While vomiting does not constitute a disease in itself, it is a condition of such frequency and occurs in such widely varying circumstances that any work relating to diseases of children would be incomplete without its consideration. Certain facts concerning this subject have already been emphasized (p. 100).

The most frequent causes of vomiting depend solely upon the functions of the stomach. When the stomach is overfilled, vomiting may result. When substances sufficiently irritating come in contact with its lining mucous membrane, whether they are swallowed or are produced by fermentation in the stomach contents, they are ejected. When there is an inflammatory involvement of the mucous membrane of the stomach, either acute or chronic in character, the organ becomes intolerant of the blandest of fluids. Another condition involving the structure of the stomach, but only occasionally seen in children, is ulceration, which is usually multiple. Vomiting is the prominent, in fact, usually the only, symptom.

**Dilatation of the Stomach.**—In this condition the food does not pass readily into the intestine, but remains in the stomach and undergoes changes which produce sufficient irritation to cause vomiting.

**Pylorospasm.**—In pyloric obstruction or spasm the food is prevented by the narrow pyloric opening from passing into the intestine, one feeding follows another, the stomach becomes overloaded, and, by reason of fermentative change in the residue, sufficient irritation is produced in connection with the spasmodic contractions of the stomach peculiar to the condition, to induce vomiting.

**Causes Remote from the Stomach.**—Delayed emptying of the stomach is not infrequently an indirect cause of vomiting. It is not generally appreciated that persistent constipation is a cause of prolonged retention of the stomach contents, although fecal retention unquestionably has an influence in prolonging stomach retention. This has been brought out in our x-ray studies. In order for the stomach to function normally it should be empty at least by four hours after a meal. When food is added to undigested stomach contents vomiting is sooner or later bound to appear; in this way mechanical agencies, such as ptosis, angulations, and the greatly elongated sigmoid, may be indirect factors in producing vomiting of a habitual nature (p. 220). In intestinal obstruction, whether due to intussusception, volvulus, peritonitis, abnormalities of structure, or impacted feces, vomiting is an invariable accompaniment, continuing at irregular intervals until the obstruction is relieved or until the child dies.

The exanthemata and lobar pneumonia are very commonly ushered in by vomiting if the onset is sudden and intense. In appendicitis in children vomiting is usually one of the early symptoms; so also, in the different forms of meningitis, it is often an early symptom, and may continue persistently during the first few days of the illness. In nephritis, with uremia, vomiting is usually present. Vomiting may be caused by fright, by shock, or by a strain of any nature, as in whooping-cough, or may be of purely nervous origin.

*Illustrative Case.*—A girl patient four years old, pale and thin, had the history of vomiting for more than a year, beginning with rather a protracted, badly managed attack of indigestion. At first there were but one or two attacks a day. Later they became more frequent, and for a few weeks before the child came under personal observation the vomiting had occurred at the table with nearly every meal, before the meal was completed. The mother was most anxious and apprehensive regarding the child's condition, was always with the patient, always fed her, and always worried constantly throughout the meal, fearing an attack of vomiting. The most thorough means of examination of the stomach failed to show anything wrong with it. After some days' observation it occurred to the writer that the presence of the apprehensive mother, in whose mind the condition of the child and the vomiting were uppermost, might be a factor in causing the vomiting. He accordingly directed that the child take her meals in the kitchen with the maid, and that the possibility of vomiting should not be mentioned. The mother was directed not to come in contact with the child in any way during the meal. We were much gratified and not a little surprised when the vomiting promptly ceased. After a few months of this régime the maid was taken ill, and the mother for one day attended to the feeding. Again the child vomited as before.

The management of the different types of vomiting will be referred to in the consideration of the various diseases with which it is associated.

### ACUTE GASTRITIS AND ACUTE GASTRIC INDIGESTION

Not a little confusion exists respecting the differentiation of acute gastritis and acute gastric indigestion. Cases of gastric indigestion are often diagnosed as gastritis. Actually acute gastritis in children is a very rare condition, while acute gastric indigestion is very frequent. Acute gastritis in the young is usually due to the ingestion of corrosive or irritant drugs. Food, unsuitable in character or quantity, or food which may have undergone chemical or bacterial change, may produce pronounced vomiting, usually transient in character. Inflammation of the mucous membrane of the stomach may be produced in this way, but according to autopsy findings it is most unusual.

Cases of persistent vomiting which are often diagnosed as gastritis are not infrequently due to obstruction at the pyloric outlet dependent upon the presence of hypertrophic stenosis (p. 215), or pylorospasm (p. 214). Any of the various forms of meningitis or encephalitis may be preceded or accompanied by persistent vomiting. Acute intestinal obstruction should be kept in mind as a cause of persistent vomiting. Acute acid intoxication may occur at any age and should always be taken into consideration before making a diagnosis of acute gastritis.

Autopsies on infants dying from acute gastro-enteric diseases, such as cholera infantum, rarely show any actual stomach lesion, although there may have been persistent vomiting for two or three days.

*Acute gastric indigestion* is manifested in sudden repeated vomiting, often with fever, always with prostration, and with apparent disgust for food. The temperature may be high—104° to 105° F.—or normal throughout the case. After a few hours there will often be evidence of bowel involvement. The stools are undigested, greenish in color, and contain a moderate amount of mucus. There may be moderate abdominal distention. The symptoms other than that of emesis may appear of little significance.

**Treatment.**—A high enema should always be given as the initial treatment in any illness of any nature in which there is acute vomiting with an absence of free bowel action. If the vomiting is continued, the management of the case, regardless of the exciting cause, is to wash out the

stomach at least once and to give no food by mouth. If the case is of more than twelve hours' duration in an infant or twenty-four hours' in an older child, colon flushings should be carried out to supply fluids to the organism (p. 855). A remedy of much value, both for infants and older children, is a solution of bicarbonate of soda, 5 grains in 6 ounces of water, given hot in teaspoonful doses at intervals of a very few minutes.

*Diet.*—After twelve or twenty-four hours' abstinence from food, small quantities of water or some very weak food may be given tentatively if the child craves it. Whey, skimmed or diluted milk, barley water, weak tea, chicken or mutton broth may be tried in teaspoonful doses every half-hour. Usually cold foods will be retained better than those that are heated. If the food or water is rejected, a further stomach rest of from eight to twelve hours may be ordered before the feeding is resumed.

*Treatment of Protracted Cases.*—In the protracted cases the stomach should be washed, at least once daily, with a 5 per cent. solution of bicarbonate of soda. It is never wise, in the event of vomiting, to attempt forced feeding, as nothing will be gained; in fact, the vomiting may be continued indefinitely, and chronic gastric indigestion established, as a result of injudicious attempts at feeding. For the persistent vomiting of infants, gavage (p. 853) may also be used. A food which is rejected when swallowed will often be retained when put into the stomach through a tube. It is from the lack of fluid that the child suffers most in the case of protracted vomiting. In such cases colon flushing is particularly valuable, as they are rarely sufficiently severe to require hypodermoclysis.

Applications of heat or counterirritation over the stomach area are of no real service, but at times are grateful to the patient. One who has treated many of these cases of acute indigestion with different forms of medication, including calomel, small doses of ipecac, oxalate of cerium, opium, etc., cannot fail to have been far more impressed with their uselessness than with their beneficial influence.

An enema, the recumbent position, and the withholding of food, with nourishment, or fluids such as normal salt solution, by the bowel, have given the best results. When the child craves food and asks for water after an abstinence of several hours, feeding may be tried, but the fact that he asks for it is by no means a guarantee that what is given will be retained. In exceptional cases rectal feeding may be required.

*Treatment of Persistent Vomiting by Drugs.*—In pronounced, urgent, frequent vomiting of undoubted gastric origin, morphin hypodermically may be required. The morphin should be guarded by atropin and given in doses of  $1/50$  to  $1/40$  grain for a child one year old, to  $1/10$  grain for a child from eight to twelve years old. The relation of the dose of morphin to that of the atropin should be as 1 is to  $1/20$ . Thus, a child who is given  $1/30$  grain morphin should have combined with it  $1/600$  grain atropin; with  $1/10$  grain morphin there should be given  $1/200$  grain atropin.

It will rarely be necessary to repeat the morphin more than once, two injections being given at an interval of from four to six hours. In all

cases the usual feedings must be resumed gradually. A trial of different foods will soon show which will best be retained.

### CHRONIC GASTRIC INDIGESTION (CHRONIC GASTRITIS)

Chronic gastric indigestion develops most frequently in comparatively young infants, and is often associated with, or is a cause of, marasmus and malnutrition.

**Symptoms.**—Vomiting and regurgitation of food are the predominant acute manifestations of the disorder, which, untreated, interferes seriously with the nutrition of the patient. The condition is almost invariably a result of slight but persistent errors in feeding—errors too small to make the child violently ill, but sufficient to keep the stomach in a constant state of unrest.

**Pathology.**—The lesions in these cases are insignificant. There may be some superficial, localized congestion at the pyloric end of the stomach; there may be destruction of the superficial epithelium and infiltration of the mucosa with round cells.

**Treatment.**—The management consists in daily stomach washings, sometimes for a long period, and an adaptation of the food to the child's digestive capacity (p. 198). While there is no one way of feeding these cases, a food of greatly reduced strength must always be given, particularly when cow's milk is used. As a rule, these children have a low fat and sugar tolerance. Usually the proteins are fairly well taken care of if the function of the stomach is not disordered by too much fat and sugar.

### GASTRIC HYPERACIDITY IN CHILDREN

A vast amount of literature has appeared relating to hyperacidity and associated conditions of the gastric contents in adults. That a similar condition may exist in young children has not been appreciated. A clinical study of the cases demonstrating high stomach acidity was forced upon us by a symptom complex which was shown by many patients and which corresponded to the symptomatology of gastric hyperacidity in adults.

**Etiology.**—Dietetic errors will usually but not invariably be found responsible for the disorder. In addition to the usual bad feeding habits, taking unsuitable food at irregular hours, eating between meals and the liberal patronage of confectionery stores and soda fountains, the habitual use of orange juice in liberal amounts on an empty stomach before the first meal is significant. In fact, the hyperacidity condition may be due to the taking of orange juice cold and undiluted on an empty stomach before breakfast.

Hypomotility and pylorospasm, both conditions not uncommon in children, cause delayed emptying of the stomach beyond the four hours that is the normal evacuation time for the runabout child. This gives rise to gastric retention, which causes hyperacidity. We have studied 109 children in regard to this point by means of the Roentgen ray, using the stomach-tube as a control in several of the cases. We find causative also the short period allowed between the first and second meal of the day. On account of family habits or because the child is a late sleeper

the first meal is delayed and not completed before 8.30 or 9 o'clock. The second meal is given promptly at 12 or 12.30, which means that the second meal is given before the first meal has entirely passed through the pylorus, and again there are retention and hyperacidity. In order that the appetite and digestion may be normal there must be no food residue in the stomach when a meal is given. Further, we have found that a rest period or interdigestive period of from one-half to one hour is required in order that the stomach functions may be carried on normally. It is to be understood that the rest period implies an empty stomach.

**Symptomatology.**—The symptoms in their order of frequency are: abdominal pain that has not been relieved by previous treatment, nausea without vomiting, vomiting at irregular intervals, and loss of appetite.

The *pain* occurs most often before meals when the stomach is supposedly empty. In many cases pain is complained of before the morning meal. At times the child is awakened early because of the abdominal discomfort. When asked to locate the pain, the child usually places the hand over the abdomen above the umbilicus. In some the pain is of a colicky character sufficiently severe to cause crying.

*Vomiting.*—With the pain there may be daily morning vomiting, or the vomiting may occur independently of pain, or the child may be nauseated and vomit before the meal or immediately after. Breakfast is usually the meal vomited.

*Nausea.*—In some there is neither vomiting nor pain, the condition manifesting itself by nausea, most prominent before mealtime, and perhaps relieved by taking food.

*Appetite.*—The appetite is variable. In most instances it is much impaired. In others the child will be eager for food, but is satisfied by a few mouthfuls, complaining of a feeling of fulness, so that further feeding must be urged.

Many children with an habitually poor appetite are victims of hyperacidity.

*Nausea and Eructation of Gas.*—This combination is not infrequently seen, and is almost always associated with an indifferent and capricious appetite. Eructations of gas and belching may be the only symptoms complained of. Mothers have stated that the eructation was so pronounced as to be embarrassing.

*Constipation.*—This is usually present; probably the small food intake has much to do with this. In cases in which the condition has existed for a considerable time malnutrition and anemia due to the defective food intake are marked. In mild cases the appetite alone is affected.

In 67 recent cases of chronic stomach disorders we have insisted on the test meal and gastric analysis, and have been surprised at the cooperation of the parents. This is to be accounted for probably by the fact that the child is brought for a condition which is believed to be serious.

**Examination of Gastric Contents.**<sup>1</sup>—*Test Meal.*—The test meal consists of 2 ounces (60 gm.) of dried bread and 6 ounces (178 c.c.) of weak tea. In one hour the stomach contents are removed by the stomach-tube.

*The Preparation of the Patient.*—The child is wrapped snugly in a

<sup>1</sup> By Dr. E. J. Lorenze, Jr.

rubber sheet, primarily to prevent struggling and secondarily to prevent soiling of the clothing by material vomited along the sides of the tube and by the profuse secretion of saliva. The child is held firmly by the assistant. After the tube has been moistened in warm water, it is passed to the posterior part of the pharynx. Older children are asked to swallow, but in dealing with the younger it is necessary to pass the tube without co-operation. A certain definite resistance is encountered when the tube strikes the greater curvature of the stomach. Usually the evacuation of the stomach contents begins immediately. The flow is accelerated by coughing, crying, and vomiting. It is frequently necessary to begin the evacuation by aspiration. We find the Hess bulb satisfactory for this procedure (p. 211).

*Technic of Gastric Analysis.*—Three separate portions of 10 c.c. of unfiltered gastric juice are placed in three small beakers. To the first portion 3 or 4 drops of phenolphthalein are added, and this is titrated with tenth-normal sodium hydroxid until a deep permanent purple is obtained. The number of cubic centimeters of tenth-normal sodium hydroxid used in titrating is then multiplied by 10, giving the total acidity of 100 c.c. of gastric contents. Three or 4 drops of alizarin is added to the second beaker, and this is titrated until a permanent violet is obtained, when the reading on the buret is made. This result is subtracted from the number of cubic centimeters used with phenolphthalein as the indicator. This is multiplied by 10 to obtain the amount of combined hydrochloric acid in 100 c.c. of gastric juice. To the third beaker 3 or 4 drops of Toepfer's reagent is added, and this is titrated until the red disappears and yellow makes its appearance. The buret is read and the result multiplied by 10. This gives the amount of free hydrochloric acid in 100 c.c.

*Results of Examination of Gastric Contents.*—Among 67 cases, 44 showed a total acidity over 60; 36 over 70; 24 over 80; 3 over 90, and 2 over 100. The 2 cases showing a total acidity over 100 were those in which there was a food residue remaining from the meal prior to the test meal. Of the 23 that were under 60, the findings were: 14 between 50 and 60; 4 between 40 and 50; 4 between 30 and 40, and 1 between 20 and 30. We have come to look upon the normal acidity in children as ranging between 30 and 40.

In the same series we determined the amount of free hydrochloric acid in the gastric contents of 59 patients. Fifteen showed the amount of free hydrochloric acid to be between 1 and 10; 17, 10 and 20; 8, between 30 and 40; 4, between 40 and 50; 2, between 50 and 60; 3, between 60 and 70, and 1, between 70 and 80. There were but 3 cases in which we found an absence of free hydrochloric acid in those investigated.

*Management.*—Three full meals are allowed: breakfast at 7.30 A. M., dinner at 12.30, a cracker at 3.30, and supper at 6 P. M. Raw fruits, fruit juices, and condiments are forbidden. Solids and liquids are to be given neither very hot nor very cold. Ice-cream and all iced drinks are excluded. Sugar is used scantily. Medication consisting of a powder composed of sodium bicarbonate and bismuth subcarbonate, each 2 grains (0.13 gm.), and magnesium carbonate, 1 grain (0.065 gm.) is given with a half glass of warm water fifteen minutes before each meal. If constipa-

tion is a factor, from 15 to 30 drops of aromatic fluidextract of cascara sagrada is given after each meal, and not in one dose at bedtime.

**Results of Treatment.**—The outcome of the treatment has been most satisfactory. Children rarely have gastric, pyloric, or duodenal ulcers. Malignant disease of the stomach is so rare an occurrence that it can be excluded. Relief with few exceptions is prompt, but the diet and the medication should be continued for several weeks. We have known relapses to occur a year or more after the cessation of treatment. When there has once been a definite hyperacidity, there is a strong tendency for it to return, and some of these patients are unquestionably in line for surgical procedure later in life.

### HEMORRHAGE FROM THE STOMACH; VOMITING BLOOD

With the exception of hemorrhagic disease in the newborn, the vomiting of blood by infants is due to ulceration of the stomach (p. 205), to purpura fulminans (Henoch's), or to accidental causes. A boy six years of age died on the third day with purpura fulminans. There were profuse hemorrhages from the stomach, from the mucous surfaces, and under the skin. In two proved cases extensive ulceration of the stomach was found at autopsy. Accidental sources of hematemesis include the swallowing of blood, which may take place as the result of a nasal hemorrhage, or from a blow or fall causing injury to the nose or mouth, or from the presence of a foreign body in one of the nostrils. Injury to the pharynx also may be followed by hemorrhage sufficient to cause vomiting if the blood is swallowed.

*Illustrative Case.*—A case of hematemesis in a well-nourished breast-fed infant five months of age was productive of a great deal of anxiety. The vomiting of blood continued for several days without the slightest evidence as to its source. This occurred two or three times a day, usually shortly after nursing, the quantity of blood being especially large after the early morning nursing. There were no cracks or fissures in the mother's nipples, nor could blood be made to exude from any portion of the nipples on reasonably strong pressure. Convinced, nevertheless, that the source must be the breast, the writer applied a breast-pump, making use of as strong suction as possible, and obtained milk with a large mixture of blood. Evidently there had been a rupture of some of the smaller blood-vessels in the gland behind the nipple. At the first nursing the child was very hungry and tugged vigorously at the breast, which doubtless explains why the early morning vomiting showed the most blood.

In hematemesis of the newborn the patient should have the advantage of the human blood injections (p. 185).

### ULCERATION OF THE STOMACH

Ulceration of the stomach is usually associated with marked gastric disturbance, such as occurs in gastritis and in the different forms of malnutrition.

Notwithstanding a large autopsy experience among infants and young children, the writer has yet to see a perforating ulcer, tuberculous or of other type. In fact, aside from those in the newborn he has seen at autopsy only 2 cases of gastric ulceration. In 3 other cases the diagnosis of ulceration was made because of hematemesis.

*Illustrative Cases.*—A child one month old repeatedly vomited blood, and eventually bled to death. At autopsy about 2 ounces of coagulated blood were found in the stom-

ach. The gastric mucous membrane was the seat of many ulcers, varying in size, none exceeding  $\frac{1}{8}$  inch in diameter.

Another patient, three months old, had chronic gastro-enteritis with occasional vomiting of blood and died from exhaustion, the autopsy showing multiple small ulcers in the mucous membrane of the stomach.

That gastric ulcerations, even of a mild degree, play any great part in the digestive disorders of infants and young children is disproved by the infrequency of the lesion at autopsy.

In treating cases of gastric disorder by stomach washing it is comparatively rare to find blood in the water siphoned off. At rare intervals the water may be tinged with blood, but the washings invariably should be continued in spite of this, as we have never known any severe hemorrhage to follow. The blood which appears under these conditions is doubtless from the capillaries of the congested mucous structure.

**Treatment.**—In the event of persistent vomiting of blood of small or large amount, which cannot otherwise be accounted for, the walls of the stomach are to be regarded as the source of the hemorrhage. Under these conditions oral feeding should be discontinued and the nutrient enema (p. 98) should be brought into use. Bromid and chloral, or stimulants, if necessary, may thus be given with the food. Adrenalin 1 : 1000 solution in small doses may be given hourly and continued for twelve hours after the vomiting ceases. After thirty-six hours water may be given in small amounts; and the usual milk mixture diluted one-half, in small quantities of 2 or 3 ounces, may also be allowed. The normal diet should not be resumed in less than a week, even in the event of entire absence of vomiting during this period.

### RUMINATION

Rumination is a rather infrequent condition, and one which is likely to be overlooked unless one is very careful to watch the vomiting child after feedings. It is characterized by the regurgitation of food after almost every feeding, part of which is actually vomited and the rest is reswallowed.

**Etiology.**—This condition occurs most frequently in children a few months of age and is often not diagnosed until the vomiting has been going on for several weeks. Rumination may also be present in older children. When practised at this age it has become a habit and occurs especially in the neurotic. In infants there may be an associated pylorospasm.

**Symptoms.**—The clinical picture is fairly characteristic, closely resembling that afforded by the ruminating animals, such as the cow chewing the cud. A few minutes after the baby gets the bottle, he will start peculiar suction movements, and presently some of the milk can be seen in the mouth, a part may spill out and part will be chewed and reswallowed. This proceeding will be repeated until the child has emptied the stomach or fallen asleep.

Such children are often much emaciated from the prolonged loss of food.

**Treatment.**—A popular method of treatment is to give food so thick that it cannot readily be regurgitated. A mixture containing  $1\frac{1}{2}$  ounces of barley flour to 1 pint of skimmed milk is cooked in a double boiler for one hour. On cooling, this forms a thick gelatinous mass. It is fed with

a spoon to the child in quantities to which he is accustomed at intervals of three to four hours. (See p. 85.)

Strauch, of Chicago, observed that the nostrils had to be open to aid the child in regurgitating the food. He therefore improvised a clamp to keep them closed for a certain time after feedings. In this way he controlled the vomiting to a great extent.

In a private patient the habit was broken by substituting another habit, less harmful. The ruminating infant was taught to use the pacifier. Sucking the pacifier proved more entertaining than ruminating.

Sedgwick advised strapping the lower jaw firmly to the upper by means of adhesive plaster, thereby preventing the rhythmic jaw action necessary for regurgitation.

A device which has served well is shown in Fig. 23.



Fig. 23.—Device to prevent rumination, showing manner of applying it under chin. Note the two buckles on top and the strap which runs posteriorly and is fastened at the distal end by a buckle.

The patient was five months old, weighed 7 pounds, 11 ounces, and showed extreme emaciation. The thick gruel feeding (p. 206) was of use only after the appliance effectually prevented the manipulation of the lower jaw and the tongue. The patient gained 18 ounces in two weeks and in four weeks had gained 2 pounds and 7 ounces.<sup>1</sup>

### PYLORIC OBSTRUCTION IN YOUNG INFANTS

Cases of pyloric obstruction may be grouped under three main divisions:

1. Simple pylorospasm in which there is no hypertrophy (Figs. 29-31).
2. Hypertrophic stenosis, in which there is tumor with marked increase in the circular fibers (Figs. 32-35).
3. Combined hypertrophy and spasm.

**Age and Sex Incidence.**—In this disease the age is of great importance as a diagnostic point. Of 38 patients reported by Still, one began to vomit within twenty-four hours after birth and six others within the first week. Pfaundler found that the first vomiting indicating the onset of the disease was between the fourth and fourteenth days in 50 per cent. of the cases; from the second to third week in 25 per cent.; and from the third to sixth week in 25 per cent. In over 60 of our own cases the vomiting never developed later than the sixth week. In one

<sup>1</sup> Kerley and Lorenze, Arch. of Pediatrics, May, 1921.

case a tumor was palpable when the infant was six days old. The symptoms may begin a few hours or days after birth, or they may not appear until the third or fourth week; occasionally not until the second month, and very rarely not until a later date. Instances of hypertrophy and stenosis of the pylorus coming on in adult life have been frequently recorded, and these may not infrequently be due to a persistence of the condition from early life. According to Ibrahim's investigations of 266 cases, the total number of cases shows a rapidly ascending curve in the first month and a reduced frequency with advancing age.

In the case of a baby five or six months of age, with a history of vomiting over a period of three or four weeks, the age alone is evidence against pyloric stenosis. In exceedingly rare cases seen in older children vomiting due to stenosis might be confounded with cyclic vomiting. Holt saw one such case.

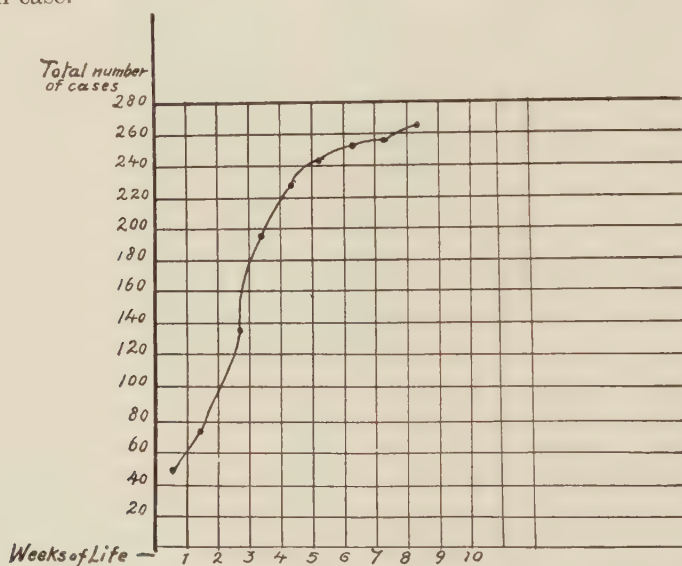


Fig. 24.—Drawn in accordance with Ibrahim's 266 cases (Pfaundler and Schlossmann's System, 1912).

*Sex.*—No great stress is to be laid on sex in the diagnosis of this disease. The large number of male patients, however, contrasts remarkably with the corresponding small number of females. Out of a collection of 42 cases in which this point was noted, 35 were males (Still). According to Ibrahim, males are affected about four times as often as females. Cases have been met in the same family (Freund). This occurred once under our observation. In another instance a brother of the patient's mother had died in infancy with symptoms typical of pyloric obstruction. Some authorities state that when the disease occurs in girl babies, it is usually of a mild form. One of our cases in which the patient was a girl was exceptionally severe despite the fact that recovery occurred without operation.

*Etiology.*—Pyloric stenosis is one of the diseases concerning which a great amount of theorizing has been done, especially in the early days,

when few autopsy specimens were at hand. Most of the various surmises have been discarded, such as the probability of the stomach undergoing an agonal contraction, thus producing the thickening (Pfaundler). Many new views, however, have been offered, as the various names of the disease might suggest. Prominent, and among the most universally recognized, theories up to 1897 were those of Hirschsprung and John Thomson. According to the former, the disease was due to a congenital organic defect, resulting from a primary pathologic hypertrophy of the pyloric wall, which constricted the lumen. Thomson contended that the essential lesion was not muscular, but primarily nervous: "A functional disorder of the nerves of the stomach and pylorus leading to ill co-ordinated and therefore antagonistic action of their muscular arrangements." This latter view corresponded very closely to Still's theory of "stomach stuttering."

There is, to date, no convincing evidence that the spasm is set up by erroneous feeding or by hyperacidity. In 7 of 11 cases Feer found the total acidity varying from 50 to 105, and free hydrochloric acid from 0 to 50. Similar results have been obtained by other observers (Ramsey, Bernheim, Karo, Engel, Freund, Miller, Clark). Miller and Willcox (1901), in a series of carefully conducted investigations, attempted to show that pylorospasm may be due to hyperacidity, and that in hypertrophic stenosis, spasm, if present, is produced by some other cause. In hypertrophic stenosis hyperacidity is very common.

Of recent years most authorities have regarded the condition as primarily spasmodic, and probably due to gastric or duodenal irritation or nervous disturbances. According to this theory the hypertrophy is secondary and depends to a large extent upon the degree of spasm. The possible existence of a certain amount of antenatal hypertrophy may be appreciated when one considers that the pylorus begins to form as early as the third month of fetal life. Such hyperplasia has actually been found by C. T. Dent in a seven months' fetus. Pylorospasm has its analogue in certain other spasmodic conditions of the circular fibers, such as constipation due to a spastic condition of the sphincter ani, and various allied conditions of the larynx and bronchi. By some observers, however, the essential condition in pyloric stenosis is regarded as a primary hypertrophy with secondary spasm.

**Pathology.** The postmortem findings are remarkably uniform. The alimentary canal below the pylorus is perfectly normal. The esophagus is sometimes noticeably dilated, sometimes of normal caliber.

The stomach is usually much dilated, the lower border being frequently below the umbilicus; the wall at the cardiac end is as thin as normal, but elsewhere much thicker, especially toward the pylorus. Occasionally the cardia may assist in the general hypertrophy. The pyloric part of the stomach consists of a rigid, resistant, cartilaginous mass of a bulging or nearly cylindric shape. The swelling appears like a separately interpolated insertion between the stomach and duodenum. When looked at from the duodenum, the pylorus seems almost closed, the mucous membrane being puckered by the contraction of the hypertrophied muscular wall, not unlike that of the os uteri. No fibrous stricture is present, and the whole narrowing seems to be due to com-

pression by hypertrophied muscle. The tumor enlargement varies from 2 to 3 cm. in length, and from  $1\frac{1}{2}$  to 2 cm. in thickness. On section, the thickening appears to be due to the hypertrophy of the circular fibers, which may be two or three times their normal thickness. Finkelstein reported a case in which the thickening was due to an increase in the



Fig. 25.—A, Drawing to indicate normal pylorus. B, Hypertrophic pyloric stenosis.

longitudinal fibers. The lumen varies in size. In some instances it barely admits a fine probe. Walbach, in one case, found the lumen 2 cm. in diameter. Occasionally a slight connective tissue increase is found in addition to a slight thickening of the mucosa and submucosa. Catarrhal



Fig. 26.—Congenital hypertrophic pyloric stenosis: Section through pylorus to show thickened muscular ring. P, Hypertrophied pyloric muscle.

or inflammatory changes are usually absent. The test of functional potency by hydrostatic pressure is fallacious, for the redundant folds of mucous membrane may act as valves.

An observation of the illustration (Fig. 26) showing the cartilaginous ring makes it obvious that spasm here would be impossible. Figure 26

further emphasizes the uselessness of drugs or any means other than operative procedures for the relief of extreme obstruction.

**Symptoms.**—Vomiting is the only active symptom of the stenosis, whether it is spasmodic or due to stricture. The history is usually that of an infant, apparently normal at birth, who remains well for two or three weeks or more. The child regains the early loss in weight, the stools are normal, and there is no suggestion of gastric disturbance. Then, without apparent cause, the child, whether breast or bottle fed, begins to reject the food.

**Vomiting.**—The vomiting may occur after each feeding. More frequently two or three nursings are retained and then a large amount is

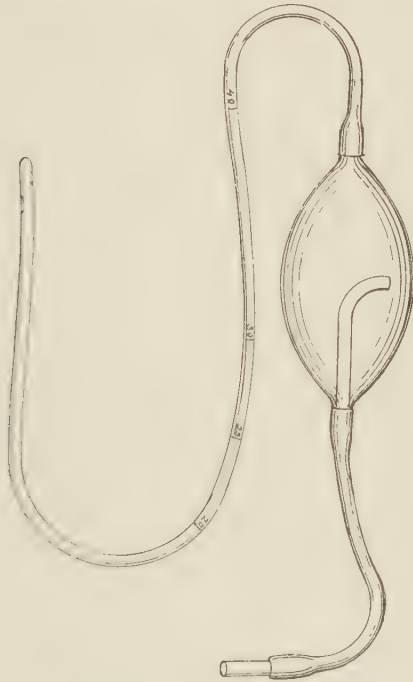


Fig. 27.—The Hess bulb.

ejected, so that the nurse or mother is impressed with the large amount of vomiting, and volunteers the information that two or three feedings would be necessary to replace the large amount of food lost. In most cases the vomiting is forcible and decidedly explosive in character.

**Retention.**—The stomach of an infant who takes from 3 to 4 ounces at a feeding should be empty at the end of three hours. When food is retained longer than three hours it means, in a vast majority of the cases, an obstruction at the pyloric outlet and is a very valuable sign in pyloric stenosis. A retention of 1 or 2 ounces is not at all unusual and when there is an associated dilatation of the stomach—two or more feedings being retained—the retention has been 4 to 5 ounces. A convenient device for testing the retention is the Hess bulb (Fig. 27). By this device

all the contained fluid in the stomach may be aspirated into the glass bulb and measured.

*Constipation.*—With the vomiting is associated constipation. The passages, previously full and normal, become very scanty, and are passed only upon rectal stimulation. Mucus is usually mixed with the feces. The degree of constipation depends upon the degree of permanency of the stricture. In the purely spasmodic cases considerable fecal material will be passed. A lesser amount will be passed in cases of the combined type.



Fig. 28.—Visible peristaltic waves. Pyloric obstruction. (John Thomson, *Clinical Study and Treatment of Sick Children*, 3d ed.)

*Loss in Weight.*—There is rapid loss in weight, as would be expected. We have repeatedly seen such infants reduced to mere skeletons.

*Appetite.*—These patients are voraciously hungry, and will take everything in the form of liquid food that is offered. Water will frequently be taken as eagerly as milk mixtures or the breast.

*Absence of Other Signs of Illness.*—There is no elevation of the temperature and there are no nervous phenomena. The urine is scanty and of high specific gravity, but shows no evidence of diseased kidneys. The child appears ill only on account of the wasting and moderate prostration.

**Diagnosis.**—In all young infants who develop persistent vomiting with constipation, or even persistent vomiting without constipation, the possibility of stenosis of the pylorus should be considered.

*The Peristaltic Wave.*—This sign consists of a rounded, circumscribed elevation of the abdominal wall, a lump from 1 to 2 inches in diameter, which forms at the left of the median line, sometimes appearing to rise from the margin of the ribs, and passes across the epigastrium (maintaining its original size in transit) to the right hypochondrium, where it disappears. In a few seconds the phenomenon is repeated. Not infrequently, before the first wave disappears a second will form. The elevation and depression may be sufficient to involve the entire abdominal wall (see Fig. 28). The peristaltic wave described occurs in no other condition.

*Method of Obtaining the Wave.*—The wave may best be demonstrated after feeding. The stomach should not be overfull. If the usual feeding time is near, 2 ounces of food or water are given. If the child has been recently fed, before giving the food the stomach is washed out. The abdomen is then exposed, and usually before the child has finished the bottle the peristalsis will appear. Occasionally a case is seen in which no peristalsis will be elicited at the first examination.

*The Tumor.*—Palpation of the tumor through the abdominal wall is possible in nearly all cases. Considerable practice is required in order to be able to locate the tumor. We have not been as successful as other writers in demonstrating this conclusive sign. Still was able to palpate the pyloric tumor in 41 out of 42 cases.

Palpation is aided by a partially filled stomach that is in active peristalsis.

*Differential Diagnosis Between Hypertrophic Stenosis and Pyloric Spasm and Obstruction of the Combined Type.*—The palpable pylorus may be looked upon as a *hypertrophic* pylorus. In a pylorus, moreover, that has undergone sufficient thickening to be palpable the connective tissue changes are in all probability sufficient to necessitate operation. Constipation is always present in stenosis of the hypertrophic form. There is dilatation of the stomach, and the vomiting is persistent. In the *spasmodic type* the vomiting appears to occur periodically—perhaps not oftener than once or twice a day. In some cases of simple spasm there may be no vomiting for a day or two, and during this time the stools will be fairly large. The short cessation will then be followed by a return of the repeated emesis. Cases of this type present the best chances for cure without operation.

In the *combined type*, in which there is moderate hypertrophy and spasm, the stenosis, when the stomach is at rest, is moderate in degree. It is possible for a considerable portion of the stomach contents to pass into the intestine if but small quantities of food are given at one time.

*Illustrative Cases.*—A case expected to undergo recovery without operation was of this type. Vomiting occurred sometimes once a day—never more than twice. The active peristaltic wave was present. The stools were fairly large and well digested, from 10 to 15 ounces of food being retained daily. Without apparent cause the child went into collapse and died. The autopsy showed a pyloric canal about 1/16 inch in diameter, and revealed moderate thickening and hypertrophy of the circular fibers.

That there may be pyloric spasm without hypertrophy, producing typical signs of



Fig. 29.

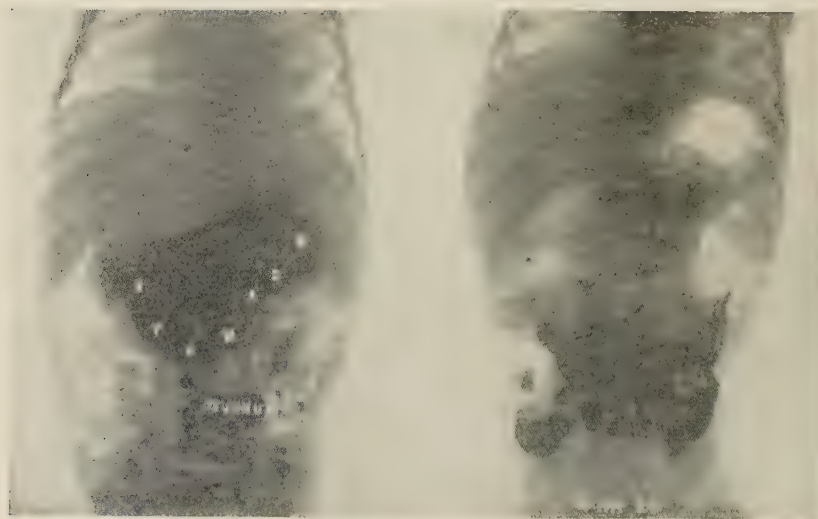


Fig. 30.

Fig. 31.

Figs. 29-31.—Pylorospasm: Male, aged eleven weeks. Weight at birth, 9 pounds, 5 ounces. When ten days old began to exhibit attacks of vomiting accompanied by fluctuation in weight.

*Roentgen Examination:* Directly after feeding. Dilated stomach with no evidences of opaque substance having passed through the pylorus (Fig. 29). Twenty minutes later evidence of active peristalsis and a slight amount of opaque meal in the jejunum (Fig. 30). One hour after the meal, stomach apparently resting, as no more of opaque meal had passed through the pylorus. Roentgenogram made about four hours later, stomach practically empty (Fig. 31).

*Comment:* The irregular emptying of the stomach was undoubtedly due to *spasm* of the pylorus which relaxed from time to time. Pyloric stenosis would probably have been demonstrated by a uniformly slow emptying; hence the diagnosis of pylorospasm. This case recovered completely without operation.

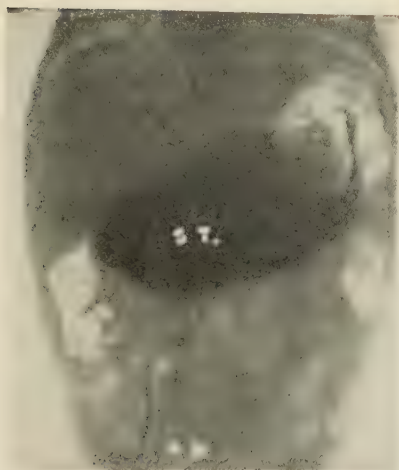


Fig. 32.



Fig. 33.



Fig. 34.

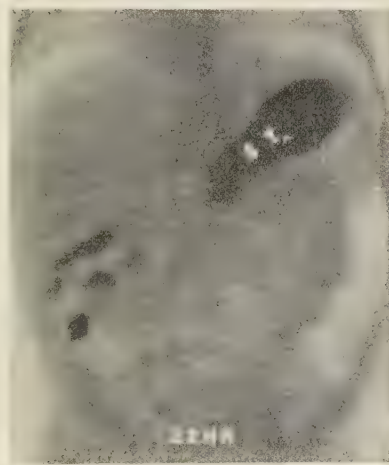


Fig. 35.

Figs. 32-35.—Congenital hypertrophic pyloric stenosis: Male, aged eight weeks. Apparently normal up to five weeks of age. Projectile vomiting for seventeen days; stools very small and green; peristaltic waves visible; an epigastric tumor palpable somewhat to the right of the midline.

*Roentgen Examination:* A most extreme case of pyloric stenosis. Twenty-four hours, some of the opaque substance still in the stomach, although the stomach had been washed out. *Atropin administered without causing observable pyloric relaxation.* Figure 32 shows the stomach four minutes after the first meal, previous to the administration of atropin. Figures 33-35: After the use of atropin—four minutes, twenty-two minutes, and twenty-two hours respectively after the second meal.

*Operation:* Pylorus showed marked thickening of muscular ring. The pyloric muscle incised according to Downes' method.<sup>1</sup>

*Roentgen examination* sixteen days after the operation showed that the stomach emptied at a normal rate.

*Comment:* The use of atropin was of no avail. Although some claim that atropin is useful in simple pylorospasm, we do not believe it can be depended upon in cases of true hypertrophic stenosis as determined by Roentgen examination.

<sup>1</sup> Downes, W. A., Congenital Hypertrophic Stenosis, Trans. Sec. on Surgery, Amer. Med. Assoc., 1920.

the disease was demonstrated by a private patient who began vomiting at three weeks. There was the peristaltic wave, the vomiting several times a day, emaciation, and constipation. Operation was partially arranged for. The child had been bottle fed, however, and preparatory to the operation a wet-nurse was solicited in order that the postoperative management might be the more secure. The wet-nurse was supplied and the baby's stomach was washed daily. In four weeks the vomiting had subsided and the child gained 2 pounds, 2 ounces in weight. There was no further trouble with the case. Here surely was not a case of organic stenosis.

**Prognosis.**—The prognosis is dependent upon many factors. The age of the patient and the nature of the surgical treatment are such that operative procedure will always show a considerable mortality.

The severity of the operation and the tender age of the subject are not the only reasons for the high mortality. Many of the patients when they come to the surgeon are so emaciated and reduced in vitality that operation simply hastens the end.

In surgical cases of children the surgeon should receive the opinion of counsel as to when and how long a condition may continue and still afford a good surgical risk.

*Cases With Palpable Tumor.*—These infants should be given the advantage of immediate operation.

In 1920 Downes<sup>1</sup> reviewed 100 cases in which the Fredet-Rammstedt operation was performed for pyloric obstruction. He recommended that medical treatment in doubtful cases be limited to a period not longer than ten days, provided the weight loss during this period did not exceed 20 per cent. The mortality among patients coming to operation within four weeks of onset of symptoms he found to be less than 8 per cent.

We are indebted to Downes and Bolling for additional information concerning cases coming under their care during a period of three years and nine months beginning January 1, 1920. Of 181 operations, all except 3 were performed at the Babies' Hospital. One hundred forty-five patients were males and only 36 females. The average age was six weeks and five days; and the average duration of symptoms three weeks and five days. A pyloric tumor was felt in every case.

In a group of 82 infants under 7 pounds on admission the mortality was slightly less than 27 per cent. In a group of 99 weighing 7 pounds and over, the mortality was slightly less than 6 per cent. The mortality for the whole group was slightly less than 15.5 per cent.

In a number of the fatal cases death proved to be due to causes independent of the pyloric condition and the operation.

This record reinforces Downes' contention that operative interference in cases of pyloric obstruction in which medical care is unproductive of prompt improvement is a conservative procedure. His results have been permanent.

*The Spasmodic Cases.*—There are probably comparatively few pyloric cases without involvement of the muscle structure. In such cases the prognosis is good, and all should survive without operation.

*In the combined cases of spasm and hypertrophy*, which represent the largest number of cases, the prognosis is dependent largely upon the degree of hypertrophy and the management. Exclusive of operation, the management of the spasmodic and combined type is the same.

<sup>1</sup> Jour. Amer. Med. Assoc., June 24, 1920, vol. 75, pp. 228-232.

**Surgical Treatment.**—The great majority of cases come to operation. In view of the fact that the presence of the tumor is difficult to demonstrate, it is not wise for the physician to depend on this sign. Frank clinical signs and symptoms in 95 per cent. of the cases mean that an organic obstruction exists and that an operation will eventually be required. When the vomiting continues in spite of treatment, and the child shows progressive loss in weight and strength, it is safe to assume that a considerable degree of hypertrophic stenosis exists and operation should not be delayed. Temporizing is safe only when there is no pronounced loss in weight. It is best to operate while the child possesses a good resistance. The Rammstedt operation offers the best results. This operation consists in making a longitudinal incision from 2 to 3 cm. in length through the serosa and the hypertrophied circular muscle-fibers of the pylorus down to the thickened mucosa. The duration of the operation, as performed by Downes, is ten to twenty minutes.

**Postoperative Treatment.**—Vomiting after operation rarely causes trouble. Regurgitation, which is troublesome, will occur in some patients. This may be obviated by bringing the force of gravity into use by elevating the head and shoulders of the patient on a high pillow. These children need fluid badly, and this may be supplied, during the first hours after the operation, by the "Murphy drip" or better by hypodermoclysis.

If breast milk is not obtainable, fresh cow's milk or condensed milk, suitably diluted, may be used.

The following directions cover the procedure developed at the Babies' Hospital, New York City, in conjunction with the Fredet-Rammstedt operation:

On admission a lavage is to be given and a two-hour retention test done, using 60 cc. of breast milk. Two hours after operation give 15 cc. of water.

Three hours after operation begin feedings on a three-hour schedule giving each of the following mixtures for two successive feedings before advancing to the next on the list:

1. Breast milk .....	4 cc.
Barley water.....	4 "
2. Breast milk.....	8 "
Barley water.....	4 "
3. Breast milk.....	12 "
Barley water.....	4 "
4. Breast milk.....	16 "
Barley water.....	4 "
5. Breast milk.....	20 "
Barley water.....	4 "
6. Breast milk.....	24 "
Barley water.....	4 "

Then give 30 cc. every three hours for eight feedings in twenty-four hours. Increase 5 cc. each day until 50 cc. is reached on an eight-feeding day. Then give 60 cc. every three hours for seven feedings in twenty-four hours. Thereafter increase 5 cc. each day until the required amount is reached. Give 15 cc. water between feedings.

Stomach-tube is to be passed before the feedings for the first seven or eight days after operation. Feed with medicine-dropper for first four or five days, then with the nipple. If patient is a nursing baby, put to breast on the seventh day, once for five minutes, twice on the eighth day, three times on the ninth day, and so on.

**Management in the Non-operative Type.**—Breast milk should always be given a trial, although this usually means the securing of a wet-nurse. In large centers breast milk may sometimes be purchased, but this means

of supply is usually quite unsatisfactory. Further, breast milk is often disappointing and is often vomited as readily as other foods. We have had both failures and successes in its use. When it fails, thick gruel feeding (see p. 85) should at once be resorted to. In preparing the gruel mixture we find the evaporated milk gives us the best results. For an infant weighing 8 pounds with uncomplicated pylorospasm or spasm and moderate hypertrophy whose vomiting, although persistent, admits of palliative measures, we would give the following feeding directions:

7 ounces of evaporated milk.  
23 ounces of water.  
5 tablespoonfuls of farina.  
1 tablespoonful of granulated sugar.

Add the 5 tablespoonfuls of farina to the 23 ounces of water, bring to a boil, simmer for one and a half hours, then add the milk and simmer for another thirty minutes. When mixture is cool add the granulated sugar. The final mixture should not exceed 20 ounces (two-thirds the original volume), and when cold should be of the consistency of soft butter.

Give 2 to 3 ounces at four-hour intervals.

A Hygeia bottle and nipple may be used if an extra large opening is made in the nipple, or the food may be given with a spoon. For the first few days water should not be given between feedings.

Smaller amounts of  $1\frac{1}{2}$  to 2 ounces are given to children weighing 5 or 6 pounds. For the first day or two perhaps not more than 2 ounces are best given at a feeding. In all cases the stomach should be lavaged with a 5 per cent. sodium bicarbonate solution daily. The thick gruel feeding may be continued for several months, the milk strength, of course, being increased from time to time.

Having used this thick gruel feeding in a considerable number of cases of persistent pylorospasm, we consider it by far the best means available in the management of the vomiting of infancy. Failures have occurred in cases with distinct hypertrophic stenosis, and without mechanical aid the method has been of very little value in combating rumination (p. 206).

*The Use of Atropin.*—A solution of atropin sulphate of which 1 drop is equivalent to 1/1000 grain is commonly administered for the relief of pylorospasm in infants. The dosage should be given coincident with the four-hourly feedings and must be governed by the effects observed; 1/500 grain exceptionally produces pupillary dilatation and flushing. If no such effect is observed and the vomiting persists the dose may be increased to 4 or 5 drops of a 1 : 1000 solution, or 1/400 to 1/300 grain at four-hour intervals. Larger doses, although recommended, have seldom been used by us.

In cases of spasm uncomplicated by true stenosis atropin is at times of value. More frequently its usual physiologic effects have been observed in our own cases without decisive relief of the vomiting, so that the results thus obtained have been at best indifferent.

#### PYLOROSPASM IN OLDER CHILDREN

The fact that pylorospasm in greater or less degree is of fairly frequent occurrence in children is readily demonstrable from the following case records:

Figure 36 shows the stomach of a boy seven years of age in a state of active peristalsis as evidenced by the circular muscular contraction with pronounced pylorospasm three hours after injection of a bismuth meal. The boy had been ill for a week following a dissipation in ice-cream and raw fruit. There had been extreme paroxysmal pain in his stomach to such a degree that morphin hypodermically had been repeatedly necessary. It will be observed that but little bismuth had passed the pylorus three hours after the food had been taken.

Figure 37 represents the stomach of a girl five years of age showing a lesser degree of pylorospasm. The radiogram was made six hours after the injection of the bismuth meal and shows very pronounced gastric retention which was repeatedly corroborated by stomach-tube examina-

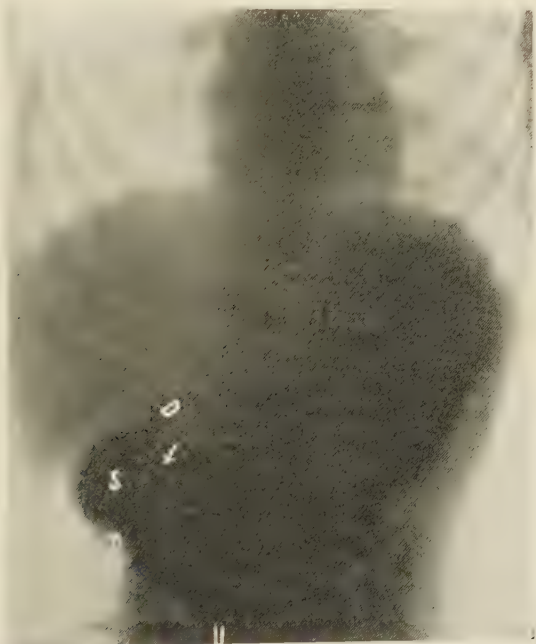


Fig. 36.—Pylorospasm in a boy of seven years: S, stomach; D, duodenum.

tion after a bismuth meal and a usual home meal. The girl was absolutely devoid of all desire for food, showed moderate malnutrition, and was habitually constipated. Enemas or laxatives were required daily. This patient was under the care of a trained nurse and did not in the least object to stomach-tube manipulation. At various times the tube was used during the night to learn the emptying time of an ordinary evening meal given at 6 o'clock. The stomach was rarely found empty before 5 A. M. the following morning. The patient had a greatly elongated and sacculated sigmoid, at least four times the normal length.

**Etiology.**—We have proved with the aid of the x-ray two causes for pylorospasm—gastric hyperacidity and intestinal stasis.

Figure 36 is taken from a case of the former, and the writer has had

other similar cases. Figure 37, taken from a case of intestinal stasis, shows evidence of sufficient spasm to produce retention.

**Symptoms.**—Gastric irritability will cause stomach hyperstalsis and spasm, so that in the cases of those patients with elongated and sacculated sigmoids and resulting stasis the emptying time of the stomach is always delayed. There apparently is direct association between the emptying time of the stomach and that of the large intestine. A peculiar feature of these cases of retention is loss of appetite. The patient will perhaps have a fair appetite for breakfast when the stomach is empty, but for the other meals must be forced or coaxed.

The most prominent symptom of the retention cases is loss of appetite, and the next in order is recurrent vomiting.

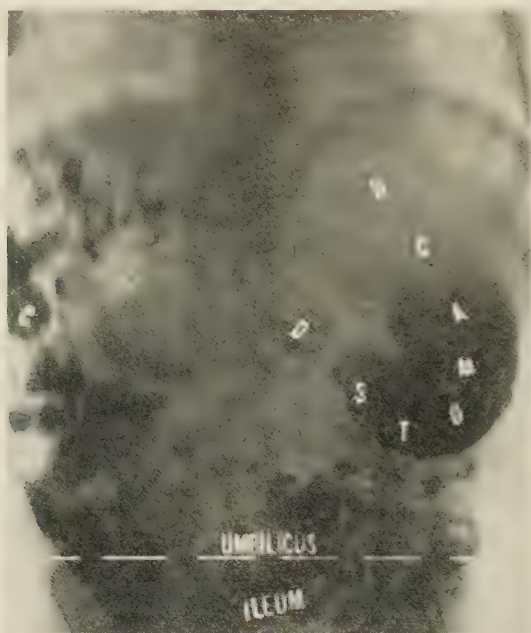


Fig. 37.—Female, five years. Pylorospasm, wandering stomach: Retention at four hours, showing large residue, corroborated by stomach-tube examination. Habitually poor appetite; malnutrition. D, Duodenum.

**Treatment.**—Relief of the constipation through treatment and a long interfeeding period goes far to restore a normal desire for food as the result of more rapid emptying of the stomach.

#### MECHANICAL DEFECTS IN THE GASTRO-INTESTINAL TRACT AS ETIOLOGIC FACTORS IN GASTRO-INTESTINAL DISORDERS OF OLDER CHILDREN

Until a few years ago children had been given the credit of having a structurally normal gastro-intestinal tract, except in those instances in which there were gross abnormalities which involved the immediate well-being or life of the infant. Appreciation of the fact that there could

be structural defects, congenital and acquired, of a bearing of more remote nature was partly the outcome of the extensive studies that have been made on congenital hypertrophic pyloric stenosis.

In clinical work among children suffering from persistent gastro-intestinal disorders it was found that in not a few cases the usual diagnostic methods (inspection, manipulation, and urine and stool examination) were not sufficient to establish a diagnosis upon which satisfactory therapy could be fashioned. Many conditions, such as the various forms of ptosis which were supposed to exist only in adult life, unquestionably have their origin in childhood, and produce as prominent symptoms in the child as in the adult. In such cases in childhood erroneous interpretations or none at all have been the custom. As a result of the abnormalities in structure, whether congenital or acquired, producing disturbed relations of various portions of the gastro-intestinal tract, derangement of function due to imperfectly carried out physiologic and chemical processes within the body becomes established, the result being in many instances<sup>1</sup> faulty nutrition, defective growth, and inferior general development of the child both physical and mental.

In x-ray studies of the stomach we find dilatation and ptosis, singly or combined, hyperstalsis and hypostalsis, pylorospasm and cardiospasm.

In the intestines an elongation of the sigmoid to three or four times its normal length is the most usual deformity. With this there are the invariable angulations, sacculations, and torsions. The colon is frequently elongated, dilated in part and entire, and ptosed. Typical V-shaped ptosis (page 223) is the usual form in which this abnormality is found.

Several cases of dilatation of the sigmoid have been observed which give a train of symptoms all their own. Anal sphincter spasm causing rectal constipation is a particular factor of importance in delayed stomach emptying and recurrent vomiting. The diagnosis of several cases of chronic appendicitis (page 291) has been confirmed by the x-ray. A continuation of pronounced gastro-intestinal disorders, particularly recurrent vomiting and persistent constipation with the patient under a proper living regime and right dietetic regulations, calls *inevitably* for an x-ray study of the gastro-intestinal tract. In the pages that follow the abnormal x-ray findings will be discussed in connection with the symptomatology of the various gastro-intestinal disorders.

#### PTOSIS AND DILATATION OF THE STOMACH

This combination we are finding in a considerable number of children who appear for treatment of persistent stomach derangements. A dilated stomach, however, may not be ptosed. Roentgen ray studies of a great many stomachs lead us to believe that Fig. 38 represents the average stomach of a child four years of age, normal in size and position.

**Etiology.** The abnormal condition in some children is probably carried over from infancy, being the outcome of a defective pylorus, and may result from a habitual overfilling of the stomach. Children who have the milk habit, who drink large quantities of milk or water with their regular meals, are very apt to have dilated and ptosed stomachs. The carrying capacity of this organ is not unlimited and the full meal

<sup>1</sup> Our x-ray studies now cover over 150 cases.

of solid food with a considerable amount of milk or water, produces an increase in the weight of the stomach contents, with gradually resulting enlargement and ptosis.

The fact that children who have had pylorospasm or actual stenosis in infancy and recover without operation are actually among those who have dilated and ptosed stomachs in later life has been proved by *x-ray* examinations of a great many personal cases, and one feature common to all is delayed emptying which has become a fixed habit.

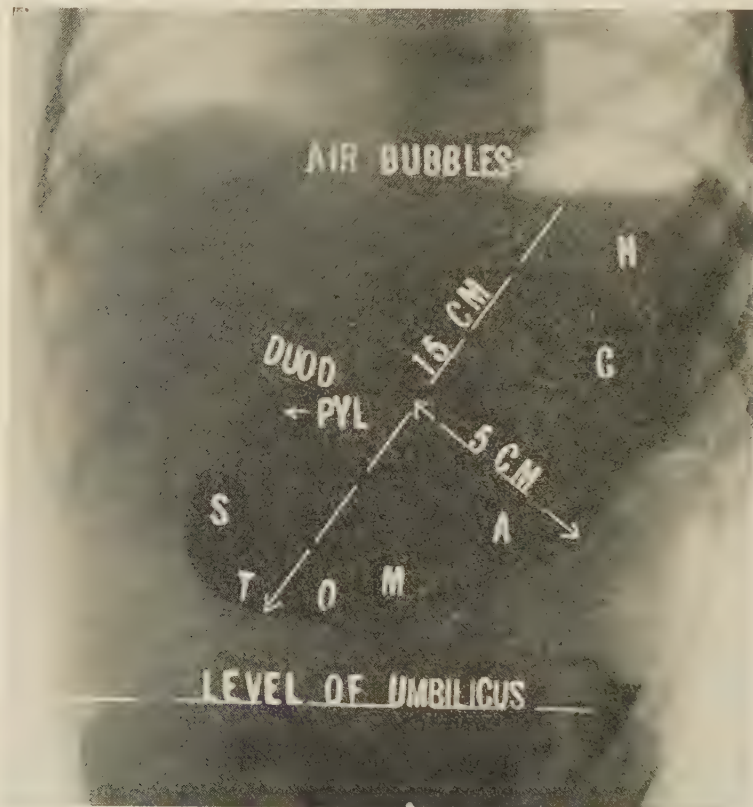


Fig. 38.—Male four years of age. Normal stomach.

After the third year the stomach should normally be empty in four hours. In one patient the stomach contained residue after ten hours and did not begin to empty for two hours. This stomach required about twelve hours to empty a bismuth meal. In 6 cases the stomach contained residue after six hours.

**The Opaque Meal.**—The opaque substance added to the food in order to give a contrast in the roentgenogram is bismuth subcarbonate, bismuth oxychlorid, or barium sulphate, especially prepared for *x-ray* work. The opaque substances are usually used in the preparation of 1 part to 8 of food for a child four years of age.

**Symptoms.**—The appetite is variable and appears to depend upon

the emptying time of the stomach. If the organ empties readily and there is an interdigestive period of one-half to one hour, the appetite is usually abnormally developed. In the event of retention of the stomach contents until the next mealtime the appetite is poor, the child has to be coaxed to eat, a vicious circle is established, and the delayed emptying helps to cause the ptosis and dilatation which, in turn, delays the emptying. It is not at all unusual for patients to show considerable stomach residue from six to ten hours after the meal. There is usually a good deal of belching and sometimes regurgitation of food, and practically all children thus affected suffer from periodic vomiting seizures which are commonly



Fig. 39.—Ptosis of stomach: This represents a dilated and ptosed stomach in a boy eleven years of age who exhibited a high grade of malnutrition, weighing only 52 pounds, and suffered from habitual constipation and periodic vomiting. His blood showed Hb. 72 per cent., red blood-cells 4,440,000. This boy rarely passed six weeks without a seizure, which lasted two or three days. Being a very wealthy boy he had passed through many hands and was treated uniformly for “acidosis.” In this case there was also coloptosis, the colon presenting the typical V-shaped abnormality depicted in Fig. 48. He was put under appropriate treatment and during subsequent observation extending over a long period never had an attack of vomiting.

diagnosed as “acidosis” attacks. In all the cases there is distention of the upper abdomen. Stomach pain paroxysmal in character, usually after eating, is not infrequent. Studies of the gastric contents show that there is usually a well-marked hyperacidity, and in cases in which hyperacidity has been proved the pain or discomfort complained of occurs more often before the meal, particularly before breakfast. Practically all such children, furthermore, suffer from malnutrition; they are thin, underweight, and irritable, and in most instances show secondary anemia and have a diminished capacity for school work and play.

In one significant case with emptying of the stomach delayed after

six hours there was a persistent urticaria for which condition previously the child was brought for treatment. She was nine years old and the urticaria first appeared at the age of two years. It was largely relieved by correcting the gastropotosis.

**Treatment.**—An important feature in the treatment of the dilated stomach whether ptosed or not is to avoid overloading the organ at any time. In order to overcome this tendency the following procedure is followed: The child is given meals with a minimum allowance of fluid

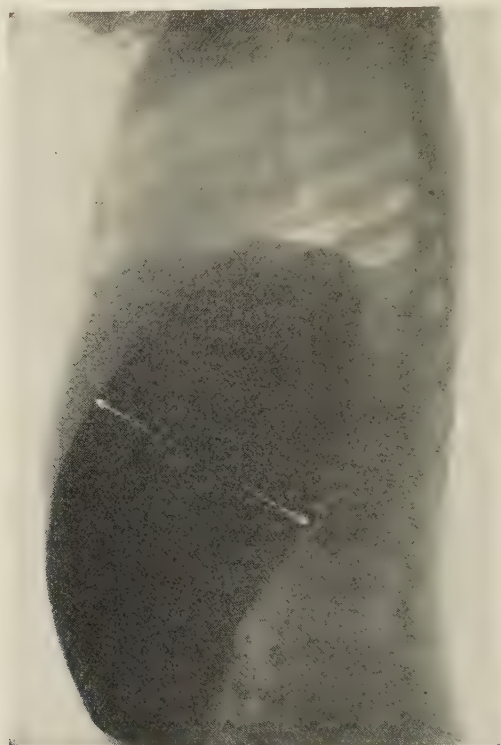


Fig. 40.—This shows extreme dilatation of the stomach of a girl six years old who weighed but 29 pounds, showed a high-grade secondary anemia, and had recurrent vomiting seizures lasting from twenty-four to seventy-two hours at intervals ranging from six weeks to two months. She had been treated for "acidosis" and had always been a difficult "feeder." The vomiting seizures began at about the eighteenth month. After the commencement of treatment there were no subsequent seizures and the child gained 13 pounds in weight in thirty months.

and is made to rest on the back or preferably on the right side for an hour after the morning and midday meal of solid food. Three meals are given daily at not less than five-hour intervals. Three hours after the breakfast and midday meal 6 to 8 ounces of milk or water is given. The evening meal is given in bed with 8 ounces of fluid. The child is made to lie down immediately after. Upon awakening the following morning as much water is given as the child cares to drink, and in one-half to one hour the breakfast is served.

Such a régime carried out for a few months will reduce the size of the stomach if there is no pyloric obstruction.

To insure further the attainment of good results children with ptosis are supplied with an Aaron band with a transverse shelf so arranged as to fit under the ptosed stomach and furnish support. To those who suffer from accumulation and eructation of gas 2-grain doses of salicin are given at mealtime or the following prescription is ordered:

R.	Magnesiae carbonatis.....	gr. xxx
	Sodii bicarbonatis.....	gr. xl
	Bismuthi subcarbonatis.....	gr. lx
M. div. in chart. no. xxx.		
Sig.—One fifteen minutes before meals, with water.		

In cases of dilatation due to pyloric obstruction pyloroplasty or gastro-enterostomy may be required.

### COLIC

A brief reference to this subject has been made on p. 100. Few children complete their first year without having severe attacks of intestinal colic. In some cases the child thrives in spite of the attacks, in others such a grave degree of indigestion exists that the condition may prove most serious. The character of both human and cow's milk, its ready decomposition in the intestine, with the formation of gas, together with the lack of development of the infant's digestive apparatus, explain in no small degree the frequency of colic in the young. When cow's milk is used, as in bottle feeding, we are dealing with a substance foreign to the infant's digestive apparatus, and often colic is the outcome. Any condition that will give rise to indigestion may, of course, be a cause of colic. Children who take too much milk, too strong milk, or who take milk too frequently are the usual subjects. Probably the most frequent cause of colic is indigestion of the protein of the milk. The protein may be given in excess or the child may have poor protein capacity. Not a few cases of colic are due secondarily to defective bowel action. A passage occurs each day, but in too small amount. There is a continual fecal residue in the intestine which undergoes decomposition with gas formation. Cold feet are often associated with colic. Fright, anger, fatigue, excitement—any condition, in short, which may make a sufficiently unfavorable impression upon the child's nervous organism—may produce indigestion and colic.

Likewise any adverse nervous mental state in the mother may produce colic in the breast baby. Constipation in the mother is not an infrequent cause.

Infants who have colic habitually more often suffer late in the day than at any other time.

Colic may be caused by an elongated sigmoid which forms angulations and prevents the natural passage of gas.

Since making our x-ray studies of the intestinal tract we have been impressed by the frequency of stomach colic at different ages. Most of us have been under the impression that the seat of the colic was usually in the intestines. In the case now cited accumulation of gas in the stomach evidently was the cause of violent muscular contractions. This capability

of the stomach muscle-fiber under such stimulation has been emphasized by Alvery.<sup>1</sup>

*Illustrative Case.*—Figure 41 represents the x-ray findings in a case of most obstinate and severe colic. The patient, a girl, aged three and a half months, weighing 10 pounds, was suffering from malnutrition, extreme colic night and day, and constipation. An enema was required daily. The Roentgen ray revealed hyperperistalsis of the stomach. The sigmoid was elongated, passing 1 inch above the umbilicus, and the stomach was distended with gas. In this case the elongated sigmoid and the obstinate constipation were the cause of the stomach colic. The fluoroscope showed the stomach in active peristalsis. The colic was entirely relieved by the use of olive oil as a laxative and by the regular feeding.

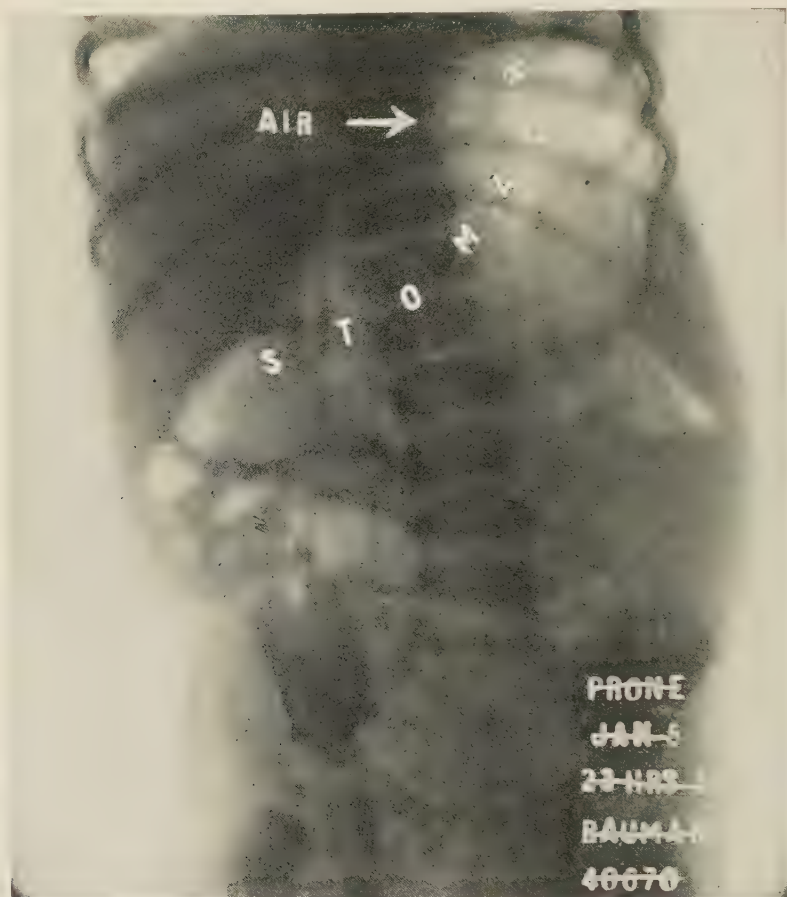


Fig. 41.—Female aged three and one-half months. Entire stomach outline can be made out owing to the presence of air. No bismuth present. (Roentgenogram by Dr. L. T. LeWald.)

**Diagnosis.**—While the diagnosis is usually a simple matter, it must be remembered that intussusception (p. 277) and appendicitis (p. 287) may cause symptoms identical with colic.

**Treatment.**—Nursing babies who suffer from habitual colic often recover after the regulation of the mother's bowels by exercise, diet, and

<sup>1</sup> The Mechanics of the Digestive Tract, Hoeber, 1922.

medication. In cases in which the mother's milk upon repeated examination proves too strong and the child suffers from daily colic, a dilution of the milk may be made by the use of plain water or barley-water, from  $\frac{1}{2}$  ounce to  $1\frac{1}{2}$  ounces of the diluent being given before each nursing. In addition, the bowels of the colicky infant should be made to move at least twice daily, morning and evening. When this does not take place readily a simple laxative, such as milk of magnesia,  $\frac{1}{2}$  to 1 teaspoonful, or 10 to 30 drops of aromatic cascara sagrada, may be given daily. Under no condition should a child subject to colic be allowed to go without a bowel evacuation for more than twenty-four hours.

*Diet.*—The dietetic management of colic in the bottle fed consists in adapting the food to the child's digestive capacity. The bottle baby may have habitual colic moderately and thrive, but is receiving an imperfectly adapted food. Here, as in the breast fed, the condition is usually dependent upon an excessive casein supply or a diminished casein capacity. The matter of the adjustment of cow's-milk protein in indigestion is discussed in detail under Milk Adaptation (p. 66). It is sufficient to say that the colicky bottle baby should have long intervals between feedings—usually one-half hour longer than ordinarily allowed. Digestion is slow in many of these infants, although in other respects they may be healthy children. In some the indigestion and pain are so severe that a perfect adaptation of cow's milk is impossible, and some other food than cow's milk will be required. The prevention of colic, then, rests upon a proper adjustment of the food.

*Enemas.*—The immediate attack is usually best relieved by the use of an enema at  $110^{\circ}$  F. of a normal salt solution, or of soapsuds, which, by inducing a movement of the bowels, allows the gas to escape.

*Medication.*—A soda-mint tablet dissolved in 1 ounce of hot water given in 1-teaspoonful dose repeated at five-minute intervals is sometimes efficacious. For a child under one year of age 3 drops of spiritus ætheris compositus (Hoffmann's anodyne) may be given in 2 teaspoonfuls of hot water and repeated at ten-minute intervals.

*Hot applications* to the abdomen are often grateful to the patient. For this purpose 10 drops of turpentine in 1 quart of water at  $120^{\circ}$  F. may be used with benefit. A flannel is wrung out of this turpentine solution and applied over the abdomen and covered with a dry piece of flannel. The dressing may be changed every ten or fifteen minutes.

Opium and its derivatives should not be used in the treatment of colic. This drug may relieve the pain temporarily, but it aggravates the condition to which the colic is due.

## PREVENTION OF THE ACUTE INTESTINAL DISEASES

The general topic of disease prevention has been touched upon in an earlier chapter (p. 133). The acute intestinal diseases of summer, with their large infant mortality, offer a better field for life-saving measures than does any other group.

Potent etiologic factors contributing to summer diarrhea are unfavorable climate and unfavorable environment. In dealing with the class which furnishes the largest mortality, climate cannot be changed for a sufficient number to exert any great influence on the general mortality. Through

education the environment may be radically improved, but it cannot be changed. The hot months come and the tenement child must remain at home. Excursions and outings of various kinds are valuable in a small way to comparatively few, as the child must return to the tenement home at night or after a few days' absence, so that in our consideration of this class of patients in large cities we must accept unfavorable environment and hot weather—in other words, we must treat these cases in their homes. Those more fortunately situated, who can have the advantage of the country and intelligent care, are proportionately less liable to diarrheal diseases. Other than climate and environment, the determining etiologic factors among all classes are: first, a disordered gastro-enteric tract; second, infected food; third, faulty feeding methods; fourth, an absence of appreciation on the part of the parents and physicians of the fact that an attack of diarrhea or vomiting, or even a single green, undigested stool, occurring in an infant under eighteen months of age during hot weather, is to be looked upon as a serious matter requiring prompt attention.

Children as well as adults are frequently exposed to disease from sources of which they are ignorant, because their power of resistance is insufficient for their protection. With milk, the most readily infected of all nutritional substances, as the chief article of diet, it may safely be assumed that few infants will pass through the heated term without being subjected repeatedly to infection from bacteria, sufficient to produce grave illness. An infant's best safeguard against intestinal infection is a strongly resistant gut. Feeding and intelligent management generally throughout the year has, consequently, a decided bearing upon summer mortality from intestinal diseases.

We have abundant opportunity to observe that the children who have frequent attacks of intestinal indigestion during the colder months furnish our severe cases during the summer. A most important feature, then, in prophylaxis is to teach the mother how to feed and care for the child all the year round, in order that, by keeping well, the child may maintain a high grade of intestinal resistance.

*Dispensary Rules of Universal Application.*—At the Out-patient Departments of the Babies' Hospital and the New York Polyclinic the senior author had abundant opportunity to come into close contact with a great many tenement mothers and tenement children. At these institutions the clientèle is fairly regular in attendance, year after year; for as one baby after another appears in the family, each is brought for treatment. At these dispensaries there is a surprisingly low summer diarrhea mortality, because the mothers are taught how to feed and care for their children all the year round. They are taught the value of fresh air, the use of boiled water as a beverage, and the benefits of frequent spongings on hot days. Both private patients and dispensary mothers have been given pamphlets of instruction and also oral teaching bearing on these points, and particularly those relating to the care of the feeding bottle and the milk. In case special articles of diet are to be given, the mothers are taught how to prepare them. Written directions are always given covering the point; nothing is left to the memory. Each mother and nurse has it impressed upon her that she must wash her hands in soap

and water before touching the baby's food or feeding apparatus for any purpose, and that there must be a covered vessel in which the soiled napkins are to be kept until washed. At the first sign of intestinal derangement, regardless of the season of the year, they are taught to stop the milk at once, to give instead a cereal water, such as barley-water or rice-water, and a dose of castor oil. It is impressed upon them that, in winter as well as summer, a green, watery stool means that the baby is ill and needs treatment. When the mother learns the above lesson for December, January, and March, she will not forget it in July. Furthermore, as a result of the immediate correction of a child's digestive disorder during the winter months, the digestive tract affords a much less fertile field for pathogenic bacteria during the summer.

*Prompt Treatment Essential.*—Comparatively few cases of intestinal diseases have pronounced toxic symptoms at the outset. At first there are evidences of a milk infection only. There may be vomiting, several green, watery stools, and a slight elevation of temperature, or the signs may comprise only one or two loose green defecations. Prompt treatment at this time, even in a crowded tenement, usually means prompt recovery. When treatment is delayed and the administration of milk is continued, severe toxic symptoms and intestinal lesions are almost invariably the result.

*New York City Experiments.*—An interesting demonstration of what may be accomplished by proper care was made under the direction of Dr. William H. Park, of the New York Health Department, during the summer season. Fifty tenement children, ranging from three to nine months of age, were selected for the experiment. These children were all fed on the Straus pasteurized milk and were visited two or three times a week by physicians especially assigned to them. The mothers were carefully instructed as to the care of the milk and the feeding apparatus, and in other necessary details. With the first signs of illness the milk was to be stopped, the physician notified, and suitable treatment instituted. Among these 50 tenement children, all under one year of age, all bottle fed, selected at random, there was not one death during the summer. This valuable observation bears out the contention that the deaths from summer diarrhea among tenement children may be greatly reduced by the use of good milk given under proper supervision, supplemented by prompt and competent medical care at the first sign of illness. Perhaps in 1 per cent. of the cases of summer diarrhea a very severe direct infection is evident, and the condition of the patient is very grave from the onset. In the remainder the invasion is gradual; and, if the warnings are heeded, the illness will usually terminate quickly in recovery.

*How to Secure Good Milk.*—To patients of the better class who go to the country for the summer, and who have cows of their own in order to control their milk-supply, the following directions have been given:

Before milking, the udders and belly of the cow should be wiped with a damp cloth to remove clinging particles of dirt. It is in these droppings containing manure that the most dangerous forms of bacteria of decomposition enter the milk. The milker should wash his hands before milking. The first few jets of milk, coming from the ducts near the openings, are apt to be swarming with bacteria, and are, therefore, to be discarded. Immediately after the milking the milk should be strained through several thicknesses of cheese-cloth, or through absorbent cotton, into an ordinary milk bottle, which is at once placed in a pail of cracked ice.

Such simple care as this, even on an ordinary farm, gives a very low bacteria count. As may readily be seen, it is attended with very little trouble and expense.

*The Necessity for Education.*—The suggestions we have offered are all included under the one general heading of Education. The mother must be educated how to live, how to care for the baby, how to clothe and bathe him during the summer. It must be impressed upon her that he needs all the fresh air available. She must be educated to the point of knowing what to do at the first sign of threatened disease. Municipalities must be educated to appreciate their responsibility as factors, negative or positive, in the summer mortality. The farmer must be educated to produce safe milk, and the consumer must be educated to appreciate its value and pay for it. Above all others, the physician must be educated along these lines so as to be able to teach the mothers how to do right in the care of their children the year round.

### ACUTE INTESTINAL INDIGESTION

This disorder is referred to first because, according to our observation, of all the intestinal disorders, it is the most frequently seen. Because its importance is not recognized the prophylaxis and treatment receive but little consideration. The proper appreciation and management of a disordered intestinal function are essential to the solution of that most important problem—summer mortality from diarrheal diseases. As pointed out elsewhere, the most fertile field for later disease is furnished by the intestine which is persistently deranged.

In June the mortality from acute intestinal disease in Greater New York in children under two years of age has repeatedly been but 300 to 500 less than in August. The high June mortality has been explained by the fact that the list included many cases of malnutrition and marasmus, but it must be remembered that the list includes also cases of infants with diminished intestinal resistance, who are ready victims to the almost invariable exposure, through infected food, to which every bottled infant is subjected at some time during the summer, when heat and humidity aid in lowering the general vitality. A close investigation of hundreds of cases of severe acute intestinal disorders of infants has shown that a great majority are not so acute as a superficial history would indicate. A complete history in a case of acute gastro-enteric intoxication (cholera infantum), or in one of apparently severe intestinal infection with resulting colitis, or one of acute colitis (dysentery), will show that the child had defective intestinal digestion during the previous cold months, and that the grave condition which he presented when brought for treatment had been preceded for two or three or more days by simple diarrhea, probably without vomiting and with little fever. The fact that the patient did have green passages and did have diarrhea indicates the existence of intestinal indigestion before the urgent symptoms of fever and prostration developed. In only about 1 per cent. of the cases of severe gastro-enteric diseases of children in summer the onset is sudden without warning, and with urgent symptoms.

**Symptoms.**—Fever is usually present in varying degree. It may be

as high as 104° or 105° F. Restlessness, abdominal pain, and moderate prostration are usual symptoms. The stools are frequent, undigested, green, and may contain mucus.

**Duration.**—Properly managed, the case has but a few days' duration. The temperature readily subsides, and the child soon shows evidence of displeasure at the reduced diet.

**Prognosis.**—The condition is serious only in the sense that it may be the starting-point of severe intestinal intoxication. Properly treated cases present few dangers.

**Treatment.**—The time to treat these cases of intestinal indigestion, in order to secure most effective prevention of severe toxemia and grave lesions, is before the physician sees the patient. The reduction in the mortality rests in the education of the mother to the point of realizing that a loose green stool is a danger signal. When it occurs, she is to give a dose of castor oil (2 teaspoonfuls), stop the bottle or stop the nursing, and give the baby boiled water or barley-water until the physician can see the patient. Every mother should at the beginning of warm weather be instructed in proper summer care of the infant.

*The Breast Fed.*—Intestinal disease of severity in infants fed entirely on breast milk is exceedingly rare. With a breast-fed baby it may be necessary to discontinue nursing for from twelve to thirty-six hours, to give 1 or 2 drams of castor oil, and to substitute for breast milk barley-water or rice-water No. 1 (see p. 94), to each pint of which  $\frac{1}{2}$  or  $\frac{1}{4}$  ounce of cane-sugar is added. While nursing is discontinued the breasts should be pumped at the regular nursing hour so as to keep up the flow of milk and relieve tension. Rarely will other treatment be required.

*The Bottle Fed.*—With the bottle fed greater caution will be necessary. The management consists in continuing the carbohydrate diet, which the properly informed mother has instituted, until the stools approximate the normal. This may necessitate an abstinence from milk for three or four days, by which time it may usually be resumed. The milk should always be given in reduced quantities for the succeeding day. One-half ounce of skimmed milk may be added to every second feeding or to every feeding of the gruel. If it is well digested and causes no return of the diarrhea, the amount of milk may be increased tentatively every day or two by the addition of  $\frac{1}{2}$  ounce to each feeding.

In some of these cases the diarrhea without fever will continue. In such instances the administration of 10 grains of bismuth subnitrate with  $\frac{1}{4}$  to  $\frac{1}{2}$  grain of Dover's powder at two- to three-hour intervals, aids materially in establishing the normal intestinal function.

## PERSISTENT INTESTINAL INDIGESTION

The special part of this subject, which has been covered in the consideration of the management of malnutrition and marasmus, is again referred to here in order to call attention to those conditions which, though mild in character, constitute so important an etiologic factor in the acute intestinal diseases of summer. We have learned that a considerable part of the summer mortality of acute intestinal diseases occurs in children who have a reduced intestinal resistance as a result of

peristent intestinal indigestion, although this may not have been sufficient to have interfered appreciably with nutrition.

A considerable number of infants do not have a normal bowel evacuation even for two days out of ten. There is constipation, which is neglected, or there is passage of undigested or loose stools. In some cases constipation alternates with diarrhea. Occasionally there is a sharp attack of diarrhea with fever. In getting the history of our cases, regardless of the nature of the illness, we often learn that the infants have undigested stools. There is a tendency to an unstable intestinal equilibrium. This condition of intestinal indigestion is ordinarily due to errors in diet involving the habitual giving of unsuitable articles of food, or of food too strong, or feeding at too short intervals.

**Treatment.**—The management of each case is determined by the age of the patient and the conditions of the family, and is discussed in the sections relating to Nutrition, Substitute Feeding, and Modification and Adaptation of Foods.

In some instances the intestinal indigestion is the result of anatomic defects or malformations in the gastro-intestinal canal.

#### PERSISTENT INTESTINAL INDIGESTION IN OLDER CHILDREN

In this condition there is disturbance of function and there may be sufficient absorption of toxins from the intestinal canal to produce a wide range of symptoms. Whether this causes pathologic conditions in other organs it is often not possible to state. One may assume, however, that such is the result. Comparatively little attention appears to have been given the subject. There is no doubt whatever concerning its etiologic importance in the nutritional and so-called functional nervous disorders of childhood. One reason why little attention has been called to the intestinal tract as an etiologic factor is perhaps because the child is not necessarily constipated. Intestinal toxemia may exist with one or two apparently normal passages daily, and even without the presence of indican in the urine.

Pain is not a necessary symptom. It is occasionally present, however, as is also abdominal discomfort involving a sensation of constriction and pressure.

The conditions in which intestinal toxemia has seemed to play a part sufficient to form a symptom complex have been habitual headache, disorders of speech, choreic in character, secondary anemia, habitual sleep talking, sleep walking, teeth grinding, and general irritability without apparent cause. Well children are naturally bright and happy. When a child is persistently cross and irritable he is not a well child. Chronic papular eczema has proved to be of intestinal origin in a considerable number of cases, particularly among the out-patient class. The condition often regarded and treated as malaria is not infrequently due to intestinal toxemia, as fever of a degree or two may be present for protracted periods, leading the physician to give at some time or other a course of quinin. Such a patient is very apt to be habitually tired and languid, and although he may be fairly bright early in the day, in the afternoon he yawns and complains of being tired and sleepy. The blood examination fails to reveal signs of malarial infection, and quinin in full

doses furnishes no relief. The appetite may be fairly normal, the tongue may show no signs of digestive disorder, although such is rarely the case. The tongue is usually coated and the appetite capricious. The symptom complex which suggests to the mother the thought of worms is usually the manifestation of intestinal toxemia.

An important feature of these cases is the continuous elevation of the temperature a degree or more daily. In not a few instances the case is proved to be one of a low type of toxemia due to milk incapacity.

*Illustrative Cases.*—A boy, aged three years, highly nervous and irritable, was afflicted with day terrors—*pavor diurnus*. The attention of the nurse was attracted to the condition when he asked that the “bugs” be removed from his lap-robe when he was in his go-cart. The time was midwinter, and there were no bugs present. On one of these occasions when asked to pick up a bug, he tried to do this with his fingers and could not understand why he could not catch them. His tongue was heavily coated and he had required a laxative every third day. There was an excess of indican in the urine. He was taking a large amount of rich cow’s milk daily. After stopping this, a full dose of rhubarb and soda was given daily and he was well in a week.

A boy five years old was brought for examination because of disturbance of speech. He had been normal until three and a half years of age, when he had difficulty in the formation of entire words. This had increased with the development of other nervous phenomena. There was marked inco-ordination in speech—*dysarthria*—due to choreic movements evidently of the tongue and laryngeal muscles. The boy was exceptionally well nourished and there was an absence of choreic movements in other parts of the body. The knee reflexes were considerably increased. He was easily excited. Hard play was followed by restless nights, and he talked in his sleep every night, regardless of the habits of the day. Inquiry into the diet failed to reveal any grave errors. He drank 1 quart of milk daily, although milk had never agreed with him as an infant. The bowels moved once daily. The movements were often of foul odor, and the mother stated that she was satisfied they were too small. The patient after three weeks showed striking improvement on a diet without milk, with a daily laxative, and made a complete recovery in three months.

A third patient was a girl six years of age who lived in the best surroundings, in a country district. She was pale, rather thin, and below weight for her age. She had been chronically tired and irritable for two years. The blood showed the existence of a secondary anemia, and the urine contained a marked excess of indican. She had been taking quantities of quinin. Her appetite was indifferent, but she had no constipation. She favored milk and was paid for drinking extra quantities to the amount of about 2 quarts daily. Marked improvement followed the withdrawal of milk from the diet and the use of laxatives.

**Treatment.**—In our experience the management of these cases which has been most successful has consisted in the discontinuance of cow’s milk, with the further dietetic restriction to but one egg every second day, and flesh food but once daily. Cereals, fruit, and vegetables may be taken as suggested in the dietary (p. 135). The use of green vegetables is particularly to be encouraged. In place of cow’s milk malted milk may be given, and to facilitate the bowel action a raw apple may be given in the middle of the afternoon. The patient should take an after dinner rest for an hour or two. If constipation is obstinate, rhubarb and soda of the following strength are recommended:

R.	Pulveris rhei.....	gr. iv
	Sodii bicarbonatis.....	gr. viij
	Syrupi rhei aromatici.....	ʒss
	Aquæ.....	q. s. ad. ʒj
M.	Sig.—One teaspoonful once or twice daily.	

If the patient can take a capsule the following is preferable for a child from five to eight years of age:

R. Tincturæ belladonnæ.....	gtt. ij
Tincturæ nucis vomicæ.....	gtt. iv
Extracti cascariæ sagradæ.....	gr. i-iiij
Sodii bicarbonatis.....	gr. iij
M. ft. capsula No. i.	
Sig.—To be taken at bedtime.	

The medication may be continued for three or four weeks, after which time 1 dram of the syrup of the hypophosphites (Gardner's) may be given three times a day. This may be alternated with:

R. Ferri et ammonii citratis.....	gr. xxiv
Elix. simplicis.....	℥j
Aquæ.....	q. s. ad. ℥iv
M. Sig.—One teaspoonful three times daily after meals.	

In the event of constipation persisting after the use of the laxative, the oil treatment (p. 273) may be brought into use and continued until the condition is relieved.

### ACUTE GASTRO-ENTERIC INTOXICATION

The gastro-intestinal tract is exposed, of necessity, to influences from without which may exert decided effects upon the physiologic processes of its different parts. It is obvious that there may be lesions in any part of its structure, and that such lesions may cause a derangement of function, if not actual disease, by transfer of infection to other parts of the tract. Thus there may be lesions, single or multiple, in various portions of the gastro-intestinal tract. There may be a simple gastritis, or an ileitis or colitis singly or in combination, entirely independent of pathologic conditions of the other portions of the tract.

The function of the gastro-intestinal tract is the final preparation of food substances for the use of the organism. These food substances are perishable in character and susceptible to bacterial influences and chemical change. Obviously, this long tube, adapted for absorption and of an anatomic and physiologic construction of most intricate and sensitive nature, offers ready fields for bacterial invasion and chemical change, and consequently is subjected to constant insult by toxic agents resulting from bacterial and chemical processes.

For the past two hundred years investigators have attempted a classification of the acute gastro-intestinal disorders, and while much progress has been made in framing a classification sufficient for bedside and teaching purposes, let no one imagine that the last word has been said. With an increase in knowledge of the subject, old theories and concepts will be disproved and new theories evolved which may share the fate of their predecessors. It is not wise to be carried away by the theories of our time concerning a subject the etiology of which is based upon so many factors, not the least important of which is that of physiologic chemistry, a subject of which we can boast too little absolute knowledge.

Until we possess demonstrable facts it is best in teaching not to go into vague chemical and metabolic theories.

**Symptoms.**—This form of intoxication, while acute in character, is rarely of primary origin. It is usually preceded by disordered gastro-enteric digestion.

The onset is sudden, with pronounced prostration, persistent vomit-

ing, retching, and the passage of large, watery stools of greenish color. The pulse is soft and rapid.

In a few hours the prostration becomes extreme, the respiration quick and shallow, the eyes sunken, and the skin dry and ashen in color. The extremities are cold; thirst is intense. The fontanel is depressed. The anus becomes relaxed, and often there is a constant slight discharge of the intestinal contents.

The temperature is variable and inconstant—it may be high, 105° to 106° F., or it may never arise above the normal. The lower temperature cases with repeated vomiting and profuse diarrhea are the most hopeless. The system is so overwhelmed by the poisoning that a reaction is impossible.

As the disease progresses toward a fatal termination the patient develops stupor and occasionally convulsions. Coma rapidly ensues, and death from a virulent poisoning process is the outcome.

An infant may die in twelve hours from the onset of the symptoms.

The loss of weight is most rapid. In twenty hours a nine-month-old baby lost 2 pounds. The loss of a pound or more in twenty-four hours is not at all unusual.

*Illustrative Cases.*—At the Nursery and Child's Hospital a child fifteen months of age was taken acutely ill with vomiting and diarrhea at 11 o'clock in the morning. The child was seen by the house physician, and suitable management was instituted. On rounds at 4 o'clock the child was found moribund in spite of active treatment, and death took place six hours later.

Thirty-one children in this institution were poisoned by a can of stale milk left by a dealer who was short of a sufficient fresh supply. Thirteen deaths in children under eighteen months were traceable to this can of milk.

Not all cases are as severe as the foregoing descriptions represent. There are cases in which there is a sharp rise in temperature to 105° or 106° F., with active vomiting and profuse watery stools. The fever soon subsides. The stomach is washed, milk is withheld, boiled water, weak barley-water, or rice-water No. 1 (see formula, p. 94) is given, and the child is well in a few days. In the more severe cases that recover several weeks elapse before the patient regains normal vigor.

The urine contains albumin, and usually a few hyaline and epithelial casts—findings that are common in all severe acute toxic processes, and have no significant bearing upon the illness.

Infants ill with intestinal intoxication not infrequently develop severe acidosis. In such cases the prostration is extreme. There is rapid breathing—evidence of air hunger without cyanosis or respiratory obstruction, and with the chest signs negative. Coma early supervenes and the outcome is usually fatal.

**Pathology.**—The postmortem findings are negligible. The stomach and intestines present a very pale, washed-out appearance. The intestine usually contains a mucoid, yellowish substance entirely free from fecal odor. The brain may show a cerebral anemia; more often there is moderate edema of the meninges—the so-called wet brain.

**Treatment.**—The management of the case depends entirely upon the nature and urgency of the symptoms. In the *acute choleraic* or so-called *cholera infantum* cases, with repeated vomiting, severe toxemia, retching, and profuse watery stools, stomach washing and bowel irri-

gations are useless procedures. We must support the patient and aid him to bear the infection with which he has to contend.

If the temperature is high and the skin dry and hot, a cool pack to the trunk, at 85° to 90° F., subsequently moistened with water at this temperature every half-hour, will often control the pyrexia. If the feet are cold, hot-water bottles should be brought into use. If the temperature is below normal and the peripheral circulation poor, as indicated by a leaden hue of the skin, a hot-water bath at 108° F. for five minutes will always be of service. The bath may be repeated at half-hour intervals.

In addition, the immediate treatment calls for hypodermic stimulation and sedatives. The administration by mouth of food or stimulants should not be attempted. Tincture of strophanthus and brandy, hypodermically, have served well in these cases. Twenty drops of brandy with 2 drops of the tincture of strophanthus may be given at intervals of one, two, three, or four hours, depending upon the urgency of the case. A combination of morphin and atropin may be used in cases with persistent vomiting, with a view to controlling the attempts at vomiting which exhaust the patient, and also to diminish the continuous loss of the fluids of the body from the repeated large, watery stools. Obviously, morphin should not be given unless this condition exists. For a child one year of age 1/50 grain of morphin may be given with 1/500 grain atropin, and repeated as required, not oftener than once in two hours. After the first year 1/30 grain of morphin may be given as an initial dose. Beneficial effects from the morphin will be noted in a diminution in the number of stools and the frequency of the vomiting.

In *milder cases of infection* in which the vomiting and defecation are less frequent, a different course is to be pursued. In these cases abstinence from food must be enforced, boiled water being given if the child can retain it. If vomiting persists, the water should be discontinued.

The stomach should be washed at least once daily and the colon irrigated. If the irrigation brings away mucus and fecal matter, it should be repeated at intervals of from eight to twelve hours. The child should never be disturbed for this purpose if the intestine continues to empty itself at frequent intervals.

A reduction in the temperature, cessation of the vomiting, and a diminution in the number and improvement in the character of the stools, tell us whether or not the case is doing well and determine the further treatment, after the initial dose of castor oil or calomel has been given. As a rule, the milder type of case does better when calomel is used. If there is a tendency to vomit, the oil will rarely be retained, regardless of how it is given. From 1/15 to 1/10 grain of calomel may be given at fifteen-minute intervals until 1 grain is given. While slower in its action, it is ultimately of more benefit than the oil, which is apt to be rejected.

*Feeding During the Attack.*—When the vomiting has subsided, teaspoonful doses of plain water, bicarbonate of soda solution, barley-water, Granum-water, or rice-water, should be given at fifteen-minute or half-hour intervals, and the amount should be increased in quantity and be given less frequently as the case improves. It is well, in using milk

substitutes, such as cereal waters, to use alternately, for the sake of variety, three or four different preparations. The child will not then so soon tire of the milk substitute as when but one is given, and will thus take more food. It is extremely rare that the substitutes barley, rice, or Granum will not be taken if used in this way, particularly if they are made more palatable by the addition of salt and sugar or saccharin. In cases showing signs of acidosis, which is indicated particularly by deep and labored breathing, bicarbonate of soda should be given at once, 10 grains every hour if possible, until the patient receives at least 120 grains in twenty-four hours. It is to these urgent cases that not only bicarbonate of soda but glucose should be given intravenously (p. 772). Intraperitoneal saline injections and even transfusion should be employed in extreme cases.

*Drugs.*—Unusual care must be exercised in the use of astringent drugs in the cases we are discussing, particularly in cases that are mild or moderately severe. It is to be remembered that it is in the intestinal contents that the trouble exists, and not in the intestinal structure, and that the diarrhea is a conservative attempt on the part of nature to protect the intestinal structure. Our first efforts, therefore, should not be directed toward stopping the diarrhea, but toward assisting in the elimination of the intestinal contents productive of the illness. The indiscriminate use of opium and astringents may do irreparable damage in a very short time through a locking up of the intestine, which may be followed by a sudden rise in temperature, convulsions, coma, and death. When there is tenesmus, with frequent large, watery stools, opium may be given with caution in small doses sufficient to control the number and character of the stools, with a view to prevention of an excessive loss of fluids from the body. This drug should never be given when there are only four or five free evacuations in twenty-four hours, associated with more or less fever, as in such cases this number is required to maintain proper drainage. The opium should further be given independently of other medication, so that its use may be stopped when the excessive number of stools ceases, or in the event of a rise in temperature after it has been given. It would not be desirable, perhaps, to discontinue the bismuth or other drugs which may have formed a part of the prescription. Dover's powder,  $\frac{1}{4}$  to  $\frac{1}{2}$  grain, given at intervals of two or three hours is suitable for a child from six to eighteen months of age. Bismuth subnitrate in not less than 10-grain doses at two-hour intervals has given most satisfactory results. In order to be of service it must produce black stools. In other words, if the bismuth is not converted into the sulphid in the intestine, it apparently is of no service, *i. e.*, if it passes through the bowel unchanged, no favorable influence will be exerted on the intestine. This lack of effect is observed in a small percentage of cases. In such an event the necessary amount of sulphur may be supplied by the use of sublimated sulphur, 1 grain being added to each dose of the bismuth. A convenient and agreeable way of giving the bismuth is the following:

R. Bismuthi subnitratis.....	3v
Syrupi rhei aromatici.....	3ij
Aquæ.....	q. s. ad. 3iv
M. Sig.—One teaspoonful every two hours.	

If sulphur is necessary, a 1-grain powder may be added to each dose of the bismuth mixture at the time of its administration. In the same way Dover's powder, if opium is indicated, may be dropped into the bismuth mixture. The bismuth is to be continued in the large doses until the child is ready for milk, when the dose should be diminished one-half and continued until full milk feeding is permissible, or until constipation contraindicates this drug. In using the bismuth in the large doses advised it is necessary that the chemically pure drug be obtained. If free nitric acid or arsenic is present, as is the case in some of the commercial bismuth on the market, vomiting may result, or symptoms of arsenical poisoning may develop. Irrigation of the colon (p. 854) may be used when there is a tendency to bowel inactivity with high temperature. If there are loose watery passages, irrigation is not called for.

*Hypodermoclysis, Intraperitoneal and Intravenous Infusions.*—The injection of warm normal salt solution into the subcutaneous cellular structure of the body is frequently advocated by pediatric writers for the very urgent cases in which there is extreme prostration and rapid loss in weight due to the persistent watery discharges. We have employed this treatment in a great many cases, but rarely have found it of great utility. In the cases where such addition of the fluid is most needed, it may not be absorbed because of the lowered vitality of the patient, while those whose tissues are able to take up the salt solution frequently do well without it. The more direct methods of intravenous glucose administration and intraperitoneal injection of saline (p. 850) are now supplanting the older procedure of hypodermoclysis, although their indorsement has been by no means universal.

**Diet.**—A difficult problem of no little importance is the nutrition of the patient after the acute symptoms have subsided. When the temperature has been normal for two or three days, and the character of the stools improves to such a degree that freer feeding than carbohydrate decoctions is to be thought of, unusual care is necessary in order to avoid a reinfection.

*Skimmed Milk.*—It must, of course, be our effort to resume milk feeding as early as possible, but in resuming milk the amount given must be increased very gradually—at first only  $\frac{1}{4}$  to  $\frac{1}{2}$  ounce of skimmed milk being given in every second feeding of the cereal gruel. In not a few cases even these small amounts will result in a rise of temperature and a return of the diarrhea. There are always pathogenic bacteria remaining in the intestinal tract after an illness of this nature, which, under the influence of such a favorable culture-medium as milk, take on renewed activity. The whole illness may, therefore, be repeated perhaps with greater severity than the original one if the milk feeding is persisted in. One repeatedly sees infants who are having what is called a relapse. What they have is a reinfection, with all the symptoms as severe as, or more severe than, those of the first infection, because of a lack of appreciation of the necessity of great care in resuming milk. To avoid mistakes in feeding at this time, as well as early in the disease, all directions should be carefully written. Nurses and mothers who think the physician is overcautious and pity the hungry child are very apt to forget oral instructions and give more milk than is ordered. If the

small amount of milk agrees, it may gradually be increased by the addition of  $\frac{1}{2}$  ounce to each feeding every two or three days. Rarely, however, will it be possible or wise to attempt to give, for the remainder of the summer, as strong a food as was taken before the illness. In milk feeding at this time a high fat content must not be used. Either full milk or skimmed milk, properly diluted, should be given. If there is a tendency to relaxation of the bowels, with frequent passages, the use of skimmed milk is indicated. Whether the milk shall be pasteurized, sterilized, or raw depends upon the conditions referred to under Sterilization and Pasteurization (p. 63).

*The Wet-nurse.*—Not a few marasmic out-patients belong to the class who, after an attack of diarrhea, cannot take even as small an amount of cow's milk as  $\frac{1}{2}$  ounce in each feeding. After a sharp intestinal infection, if the baby shows inability to take a nutritious diet, a wet-nurse may be secured for the well-to-do, but the wet-nurse's milk will not always agree. Children who have been very ill with any of the severe forms of acute intestinal disease of summer have, as a result, a very weak fat capacity, and the wet-nurse's milk, which perhaps contains 3 or 4 per cent. of fat, may produce diarrhea sufficient to require its discontinuance. When employing the wet-nurse in such cases it is accordingly best never to permit the child to have the full allowance of breast milk at first. To an infant from three to six months of age, for example, it is well to give 2 or 3 ounces of barley-water or a 5 per cent. milk-sugar-water before each nursing, so that the patient will be satisfied with 2 or 3 ounces of the breast milk. When cow's milk cannot be given and the nurse's milk does not agree, or where for any reason a wet-nurse is not possible, we are called upon to furnish other means of nutrition, and this, with our available resources, will not be of a very high order for infants under one year of age.

*Animal Broths.*—The animal broths are of very little service. They contain but little nourishment even if given in considerable quantity and may produce a decided laxative effect during convalescence from diarrhea. They are of value only in small quantities of an ounce or two added to the gruel to make it more palatable.

*Cereal Decoctions.*—Strong starch foods cannot be digested in sufficient amount to maintain the nutrition. Dextrinizing processes are therefore of considerable service. The starch is thus converted into maltose, which is readily assimilable. With this, as with the broth, the relaxing effect of the food on the intestine may be felt, frequent bowel evacuations being a possible result. The dextrinized gruels, however, are always worthy of trial, and they have been of considerable service as a substitute for cow's milk.

*Condensed and Evaporated Milk.*—When breast milk is not available, condensed milk usually answers better than any other food, being much more easy of digestion than fresh cow's milk. The condensed milk at first is to be added in small quantities to the cereal water made from barley, rice, or Granum, No. 1 strength being employed. (See Formulary p. 94.) One-half dram may be added to every second feeding for the first day, and on the following day this amount may be added to every feeding. The condensed milk usually will be well taken and well di-

gested. It should be gradually increased until 2, 3, or 4 drams are added to each feeding. When it seems desirable to use more than 2 drams at each feeding, unsweetened evaporated milk, if obtainable, furnishes an increased amount of protein and fat without the excessive percentage of sugar. In not a few cases the combination of evaporated milk and cereal diluent must furnish the nourishment for the remainder of the heated term. With the advent of cooler weather, 1 ounce of weak raw milk with the cereal diluent may be substituted for one of the regular feedings, and later this may gradually be increased  $\frac{1}{2}$  or 1 ounce at a time until the raw milk comprises one-third of the food mixture. When this point is reached, an attempt may be made to replace with raw milk another feeding of the evaporated milk. In this way, by carefully watching the case, a gradual replacing of the evaporated milk by fresh raw milk feeding may successfully be brought about until raw milk only is given.

*Feedings After the First Year.*—After the first year similar methods may be followed if necessary, although at this age plain milk will usually be tolerated earlier, and other means of feeding than the milk may be brought into use. Zwieback, bread crusts, and scraped beef—2 or 3 teaspoonfuls a day—will often be taken without inconvenience when milk in sufficient amount for proper nutrition disagrees. At this age the gruels also may be made stronger. No. 2 or No. 3 (see Formulary, p. 94) will often be well borne. An important point to be remembered in feeding convalescents from an acute gastro-enteric disorder is that the food must not be forced, and that the child must be fed only in accordance with his digestive capacity. This can best be determined by watching the temperature and the stools. The gruels as substitute foods, whether alone or combined with condensed milk, may be given in quantities equal to those which the child was accustomed to take in health, and they may be given at more frequent intervals, never, however, oftener than every two hours. A child who has been fed at four-hour intervals may take the substitute at three-hour intervals. If fed at three-hour intervals, he may receive the substitute at two- or two-and-one-half-hour intervals. When constipation follows a sharp attack of diarrhea, an enema may be used not oftener than once in twenty-four hours. The patient should not be given a laxative for several days after the acute symptoms have subsided unless there is fever.

*Protein Milk.*—For young infants—under nine months or thereabouts—protein milk (p. 88) may sometimes be used with good effect. The taste, however, is not agreeable to older children, many of whom refuse it. In such instances saccharin may be used for sweetening purposes. At first, after the acute symptoms have subsided, the protein milk is to be given with barley-water, 1 part of the milk to 3 parts of barley-water. This may be rapidly increased to equal parts of protein milk and barley-water. It is not wise in most instances to give the milk stronger than this dilution. The protein milk is often retained and digested more readily than cow's milk, may be given in larger daily amounts, and is a valuable means of sustaining the child for a few days or a week until cow's milk or condensed milk (p. 78) may be tolerated.

*Termination.*—The termination of acute gastro-intestinal intoxication is in death, prompt recovery, or in the development of ileocolitis.

The transition to an ileocolitis in some cases is so sudden that its existence from the onset is often assumed. That such is not the case is proved by autopsy experience in hospital and institution work, with cases dying in a day or two from toxemia, in which no intestinal lesions of consequence are found. The continuation of fever and diarrhea, with loose green mucous stools, means that an ileocolitis has developed as a result of the toxic agents in the intestine.

#### ACUTE ENTERIC INTOXICATION

This type of intoxication differs clinically from the foregoing in that there is no vomiting and rarely fever. Any elevation of temperature occurring is usually no more than a sharp rise to 105° or 106° F., and is of very temporary duration. In the great majority of the cases there is no such elevation, and more often during the entire course the temperature is subnormal.

The presence of moderate fever is a favorable sign, and indicates a more favorable prognosis. The clinical picture is similar to that of a case of gastro-enteric intoxication in that the prostration is extreme, the extremities are cold, the eyes sunken, the fontanel depressed, and the features drawn and pinched. Convulsions and muscular twitchings are often present. The mental condition is dulled, and the child lies in a semistupor, offering little or no resistance when disturbed. Diarrhea may be severe, or there may be constipation, with or without tympanites. In some cases there is an intestinal paralysis sufficient to resist all attempts at an evacuation. In such instances death may occur in twenty-four hours from the onset without a degree of temperature and without a sign of diarrhea. If an evacuation occurs, it usually consists of green, mucous stool, which may be very offensive, although this is not always the case.

The milder cases are characterized by an elevation of the temperature and varying degrees of prostration.

**Pathology.**—The intestinal lesions in these cases are of slight significance. There is perhaps an area of congestion here and there in the lower ileum or colon, with enlargement of the solitary follicles and epithelial desquamation.

**Treatment.** As mentioned above, there may be moderate diarrhea or marked bowel inactivity. In both conditions castor oil in doses of never less than 2 drams is to be given. Milk should be discontinued whether the patient is bottle fed or nursed. As a substitute, barley-water, rice-water, or Granum-water No. 1 (p. 94) may be given, with salt and cane-sugar or saccharin added for flavoring purposes. The treatment of these cases is facilitated by the fact that, owing to the absence of vomiting, the food is usually well taken throughout the entire illness, the patient ordinarily being very thirsty. In the event of excessive diarrhea—a rare condition—the indications for medication are the same as those given under Acute Gastro-enteric Intoxication (p. 237). Castor oil or bicarbonate of soda is to be preferred to calomel at the beginning of the illness.

*Intestinal infection with defective bowel action (paralytic ileus)* often occasions the most difficult cases and requires special treatment. In

this type poisons generated apparently in the intestine seem to be of such a nature as to cause a partial paralysis of the small intestine, so that often, only with the greatest difficulty, can an evacuation be induced. So difficult is this, in fact, that the possibility of an acute peritonitis or an intussusception may occur to the physician. It is then very necessary to maintain bowel action and to prevent the accumulation of gas, which, by distending the intestine, increases the tendency to constipation and toxemia.

*Illustrative Cases.*—A case in point is that of a female infant nine months of age who had been most difficult to feed. In July she developed a sudden fever of 105° F. and convulsions, which were followed by muscle twitchings, head-rolling, and marked prostration. The temperature was uninfluenced by local means, although there was no diarrhea or vomiting. The attending physician, anticipating intestinal infection, gave calomel in divided doses with frequent bowel irrigation. Foul-smelling fecal material came away with the irrigation, but the temperature and the nervous symptoms persisted; in fact, the condition became worse. After the child had been ill ten or twelve hours  $\frac{1}{2}$  ounce of castor oil and a high irrigation of normal salt solution at 80° F. were given. As a result there was one small green movement in addition to what came away with the irrigation, which was considerable. The patient was somewhat relieved and the nervous symptoms measurably subsided, though the temperature still ranged between 104° and 105° F. As a result of the calomel,  $1\frac{1}{2}$  grains of which had been given, and the  $\frac{1}{2}$  ounce of oil, a free diarrhea had been expected. It did not, however, occur. Directions were then given that  $\frac{1}{2}$  ounce of castor oil be given daily in addition to the irrigations every eight hours. This was followed by slight improvement in the symptoms, but five days of the treatment were required,  $\frac{1}{2}$  ounce of oil and 1 grain of calomel being given daily, with abdominal massage, before the resulting peristalsis was sufficient to relieve the intestine of its contents. After the establishment of free bowel action the child recovered.

A similar case which resulted fatally was seen in consultation. In this patient, a girl eight years old, the toxemia was intense. There appeared to be almost complete paralysis of the small intestine, and only small, very foul evacuations could be induced in spite of the most active measures. This child died from toxemia before free bowel action could be established.

The management of these cases of the inactive type is partially illustrated in the histories above given. Our efforts are to be directed toward supporting the patient by the use of stimulation, given hypodermically or by the stomach, and by the use of a milk-free diet, powerful laxatives, and frequent colon flushings. Castor oil may be required repeatedly, and should be given freely in doses of at least  $\frac{1}{2}$  ounce every twelve hours, until four or five passages in twenty-four hours result. Bicarbonate of soda (p. 237) is given with beneficial results in cases of this type. While the fever, prostration, and bowel inactivity persist it is necessary to continue the irrigations. In a few cases apparently better results have been secured by using for the irrigations cold water (70° to 80° F.), with the addition of Epsom salts, 1 ounce to the pint.

*Stimulants.*—Because of the tendency to convulsions and nervous irritability strychnin should not be given. The tincture of digitalis or strophanthus answers better than any other heart stimulant. Alcohol should be used only under the most urgent conditions of prostration. Atropin sulphate, from 1/1000 to 1/400 grain given hypodermically, is probably our most valuable drug for immediate stimulation. It may be repeated at four- to six-hour intervals. A combination of tincture of strophanthus and brandy, or digitalin and brandy, given hypodermically is of value. For a child six months of age 20 minims of brandy with 1

drop of tincture of strophanthus, or 20 minims of brandy with 1/300 grain digitalin, may be given and repeated every two hours if necessary, according to the requirements of the case. After the first year children may be given as much as 1/100 grain of digitalin or 2 drops of the tincture of strophanthus.

*Irrigation of the colon* (p. 855) is a measure of inestimable value, both for its immediate local effect and also for increasing general peristalsis and thus emptying the small intestine. An increase of the peristalsis is sometimes well secured by the following procedure: After the colon is washed with a normal salt solution at a temperature of 95° F. the tube is introduced as far as possible and 8 ounces of saline at 60° F. is allowed to escape. The tube is immediately withdrawn and an attempt is made, by elevating the buttocks and pressing them together, to have the child retain the solution for a few moments.

In using nutrient enemata and in colon flushing for purposes of supplying fluids to the circulation we have found that the solution is best retained when introduced warm—at a temperature of about 100° F. The cooler the solution, the more quickly is it expelled through exciting peristalsis. This fact may be taken advantage of in these cases of bowel inactivity. After an enema of cool water peristalsis of the small intestine will often result in the passage of a considerable quantity of its contents into the colon, to be expelled later with the water. The action of the cool water will be further assisted by light abdominal massage maintained after the tube is removed. Recovery may follow the clearing out of the intestine, or an ileocolitis may result, as in gastro-enteric intoxication. The process of transition from enteric intoxication to actual ileocolitis may require but a surprisingly short time, and if recovery is not prompt, ileocolitis will almost certainly be the outcome.

Upon resuming the milk diet the precautions relating to the use of cow's milk, referred to under Acute Gastro-enteric Intoxication (p. 238), must be observed.

### ACUTE ILEOCOLITIS (DYSENTERY)

In dysentery there is a well-defined infection of the intestine. In common with other intestinal disorders it occurs most frequently during the hot months, the later summer and early autumn supplying the most cases. In like manner this disease often follows the milder gastro-intestinal derangements that are productive of reduced vitality and diminished intestinal resistance.

**Bacteriology.**—In a large percentage of cases of infantile diarrhea associated with blood and mucus in the stools the dysentery bacillus is present. It may be found in large numbers, sometimes in almost pure cultures. Duval and Bassett, in 1902, were the first to find *Bacillus dysenteriae* in the stools of cases of infantile summer diarrhea. The type of the bacillus which does not ferment mannite (the Shiga type) is not found so often in these cases as are the two mannite-fermenting types: the Flexner-Manilla and the Hiss-Russel, of which the former ferments maltose, saccharose, and dextrin, and the latter does not.

The presence of agglutinins in the blood of the patient is evidence of the causal relationship of *Bacillus dysenteriae* to the existing disease.

The agglutinins are not present, as a rule, until the second week of the disease.

**Pathology.**—The lower portion of the ileum—rarely more than 3 feet—and the colon are the locations of the lesion which may show a wide variation in intensity, depending on the character of the infecting organism and the resistance of the patient. While the major lesions are usually in the colon, the small intestine shows pathologic changes in at least 35 per cent. of the cases. There may be localized areas of congestion through the mesenteric enlargement of the solitary follicles, and swelling of Peyer's patches. In nearly all cases, whether the lesions are mild or severe, moderate swelling and congestion of the mesenteric glands may be noted.

The inflammation may be acute or chronic, and catarrhal, ulcerative or pseudomembranous in type. Although the term "dysentery" is properly used to denote only infections by the bacilli of Shiga and Flexner and the special protozoon, *Amoeba coli*, the lesions produced may be conveniently considered under the term "ileocolitis."

In a series of 82 autopsies upon cases of ileocolitis Holt found follicular ulceration predominant in 36, catarrhal inflammation in 26, membranous inflammation in 14, and catarrhal inflammation with superficial ulceration in 6. Of 412 cases studied by Holt and Flexner in 1903, 270 showed the presence of *Bacillus dysenteriae*, the Flexner acid-forming type of organism appearing most frequently. Strains intermediate between the Shiga and Flexner bacilli are occasionally found, and in the causation of a certain proportion of cases of epidemic dysentery *Bacillus pyocyaneus* has been shown to be active. Amebic dysentery is common only in tropical or subtropical regions.

In *simple ileocolitis of the mild catarrhal form* the submucosa is but slightly involved. The mucosa, however, is swollen, congested, covered with secretion, and dotted with occasional points of hemorrhage and spots of epithelial exfoliation. The lymph-follicles are swollen and hypertrophied, and the adjacent connective tissue is infiltrated with round cells. Microscopically, this infiltration is also apparent about the vessels in the submucosa. The stools are ordinarily green and thin in consistency, and contain mucus, desquamated epithelium, and traces of blood. In severe cases the inflammation acquires the ulcerative or membranous character, the lymphoid follicles are elevated and superficially necrotic, and the submucosa is infiltrated with pus. In such instances the ulcerations extend deeply, and exceptionally involve the entire intestinal wall.

**The Ulcerative Form.**—In ulcerative ileocolitis the ulcers may originate in the solitary follicles, and are then small, superficial, round, yellow, sharply defined, and surrounded by an inflammatory zone. Later the ulcers may grow larger, coalesce, and become deeper, exposing the submucosa or even the muscularis. Ulcers may also originate in the mucosa itself and not in the follicles, this may occur in dysentery or in cases of severe catarrhal inflammation. As a consequence of the coalescence of these ulcers the mucosa has a ragged appearance, with islands of gray or congested mucous membrane visible between the irregularly shaped ulcers of all sizes. Small ulcers heal completely, but large ulcers rarely undergo such healing. Stenoses as the result of cicatrization of these ulcers do not occur in children. In cases of long standing all the intestinal coats

are thickened due to inflammatory infiltration, and the mucosa becomes pigmented.

In *pseudomembranous ileocolitis* the intestinal mucosa is covered with a fibrinous exudate, which can be rubbed off at first, but later is very adherent. The mucosa becomes necrotic, and larger or smaller areas are lost, leaving a congested, edematous base, surrounded by necrotic tissue. The pseudomembrane becomes colored yellow or greenish by the feces. The wall as a whole is thickened. The lesion is usually most marked in the colon, but the lower ileum is often involved. Healing may occur, but is rare; death is the rule.

**Associated Lesions.**—In severe cases of ileocolitis the mesenteric lymph-glands are involved and the spleen may be enlarged. Perforation of the bowel, abscess of the liver, nephritis, and bronchopneumonia are occasional complications.

**Symptoms.**—A great deal of confusion has been occasioned by attempts at a nomenclature of the acute inflammatory diseases of the intestine which shall make the clinical aspect of the cases fit the pathologic findings. Differentiation, antemortem, into catarrhal, follicular, and ulcerative types is impossible, as has been proved by the care and daily observation in institution and hospital work of cases that have later come to autopsy.

Consider briefly, for illustration, the gravest cases—cases which at autopsy show most extensive ulceration of the intestine. In many of these there has been a low temperature—from 100° to 102° F.—and the stools have never contained a particle of blood. In others in which perhaps considerable blood has been passed for several days, there is but a mild congestion of the mucous membrane of the large intestine. In still other cases which continue for a considerable time—from two to three weeks—with moderate temperature, death results from exhaustion, and autopsy shows nothing but an enlargement of the solitary follicles, with areas of congestion in the lower portion of the small intestine.

Acute ileocolitis may be the primary intestinal disease. In this condition the temperature is usually considerably elevated at the commencement of the illness—103° to 104° F. After an evacuation of two or three undigested stools the passages consist of light-colored mucus, often streaked with blood, or they are of green mucus and streaked with blood. In some cases there is a considerable hemorrhage. Relaxation of the sphincter and prolapse of the rectum are not at all unusual. The passages are small, frequent, and attended with considerable pain and tenesmus. Repeatedly from twenty to thirty such passages will be observed from one patient in twenty-four hours.

Far more frequently, however, this condition follows acute gastro-enteric indigestion or an intestinal infection, the dangers of which have not been appreciated, and which, in consequence, has been improperly treated. The lesions produced are due to the bacteria and their toxins, which have abundant opportunity to produce pathologic changes in the intestinal mucous membrane, the extent of which can only be conjectured during life.

An important feature of some of these cases is that an extreme degree of toxemia, with resulting prostration, may be present, with little fever

and insignificant bowel symptoms. In other cases the bowel manifestations are very active and the toxemia is slight. The active cases offer the better prognosis. Vomiting may be present at the onset of the attack, but is not usually a symptom of consequence. There is always emaciation. The degree of prostration is dependent upon the amount of toxemia, the extent of the lesion, and the management of the case, particularly as relates to supportive measures and nutrition.

**Duration.**—The duration of ileocolitis is longer than that of any of the intestinal disorders previously mentioned. With the disease established it is rare for a case to recover under ten days. Oftener the duration of the illness is two or three weeks and we have repeatedly known cases to continue over four weeks. In fact, the duration in many instances is similar to that of typhoid fever. The temperature range is variable—from normal to 104° F. For three or four weeks in a given case there may be a low temperature range—99.5° to 101.5° or 102° F.

**Treatment.**—Recent work in the bacteriology of the acute intestinal diseases has added little to our practical knowledge as to the treatment of the condition, and consequently does not call for discussion here. Milk is to be stopped at once, whether the patient is breast fed or bottle fed. Barley-water, Granum-water, or rice-water No. 1 (see Formulary, p. 94) constitutes the basis of diet for children under one year of age. Older children may be given the No. 2 mixture. To these carbohydrate foods may be added an ounce of chicken or mutton broth, with salt or sugar to make them more palatable. It is well, for variety, to make up two or three cereal preparations and alternate their use. In this way the foods will be better taken and for longer periods than if but one is prepared. In this form of substitute feeding an amount similar to what the child was accustomed to in health may be given, but the intervals may be shorter by one-half hour or one hour.

To patients of any age two or three feedings of protein milk (p. 88) may be given daily. It supplies additional nutrition, and if the disease is prolonged, there is correspondingly less emaciation. In using the protein milk it should at first be diluted with barley-water— $\frac{1}{4}$  milk to  $\frac{3}{4}$  water at first, to be increased to  $\frac{1}{2}$  milk and  $\frac{1}{2}$  barley-water. In cases in which the standard protein milk is not well taken or is vomited, the improved product made from evaporated milk (p. 78), with a shortened incubation period, has been often employed with much advantage.

**Drugs.**—One has abundant opportunity to test the value of the different drugs advocated from time to time for the treatment of this disease. Drugs which have proved of unquestioned value are castor oil, subnitrate of bismuth, and opium. Drugs which have an occasional application are sulphur and the preparations of tannin. Constitutional measures, supportive in character, such as heat and stimulation, are, of course, used when indicated, as in any severe exhaustive illness.

At the commencement of the attack 2 drams of castor oil should be given. If this is not retained, from 1 to 2 grains of calomel should be given in divided doses— $\frac{1}{4}$  grain every hour. In cases with considerable fever and infrequent stools it is well to repeat the oil or give some other laxative, such as magnesia, every two or three days.

Bismuth subnitrate is best given in 10-grain doses, according to the

suggestions on p. 237. If black stools do not follow its administration, 1 grain of precipitated sulphur may be added to each dose. To be effective the bismuth must be given in large doses; 2 or 3 grains at intervals of two or three hours are of no value. To patients over one year of age 15 to 20 grains are frequently given at two-hour intervals. The writer has used bismuth extensively for children during the past twenty-five years, and has yet to see harm resulting from its use. Of course, the physician must use a pure article. Not a few cases do admirably under the cereal-water diet, castor oil, bismuth, and sulphur. Tannalbin, in doses of 2 grains for infants, and from 5 to 8 grains for older children, is sometimes of service when there is a tendency to large watery stools or stools containing large quantities of mucus. This drug also may be given at the same time as the bismuth.

When there is much pain and tenesmus, with frequent, scanty, mucous stools, opium may be used with advantage, with a view to controlling the tenesmus and diminishing the frequency of the stools. Paregoric or Dover's powder is usually selected for this purpose. Dover's powder is preferred, because of the absence of a disagreeable taste and the convenience of its administration. It may be added to the bismuth at each dose, not combined with it in a prescription, for uncombined it may be at once discontinued or given in smaller doses upon a diminution in the number of the stools.

Careful instructions should be given when prescribing opium. It is to be given for a definite purpose—to prevent straining and the frequent passages due to excessive peristalsis. As in the treatment of acute intestinal infection, particularly if there is temperature, it is not well to attempt to reduce the number of the stools below four or five in twenty-four hours, and, of course, opium is not to be given at all unless the stools are very frequent. The amount of opium that will be required in a given case may readily be determined by carefully watching the character and frequency of the stools. For children under one year of age the dosage of Dover's powder is from  $\frac{1}{8}$  to  $\frac{1}{2}$  grain at two-hour intervals, not more than seven doses being given in twenty-four hours. From the first to the tenth year the dose ranges from  $\frac{1}{2}$  grain to 2 grains. Mothers and nurses should be instructed that when there is a rise in the temperature, or when the child becomes drowsy after its use, the opium is to be discontinued or the dose reduced one-half—another advantage of giving it independently. The younger the child, the greater caution to be observed.

When heart stimulants are necessary the tincture of strophanthus may be used in case digitalis is not well borne by the stomach. Because of its unfavorable effect upon both the stomach and the kidneys, alcohol should be given with caution, and when used should be well diluted and given only temporarily—during the urgent period of acute toxemia. Prolonged use of alcohol invariably interferes with the stomach function.

Caffein sodio-salicylate, in  $\frac{1}{2}$ - to 1-grain doses at two-hour intervals, and atropin,  $\frac{1}{60}$  to  $\frac{1}{30}$  grain at four-hour intervals, are particularly useful in the asthenic cases. For threatened collapse camphor, 1 to 2 grains hypodermically in oil, answers well, but requires frequent repetition at one- to two-hour intervals. Adrenalin 1 : 1000 solution in 2- to 3-drop doses, hypodermically, is also of much service in collapse.

*Hot Applications.*—Hot stupes or hot compresses to the abdomen are often most grateful to the patient when there is abdominal pain and tenesmus. The hot applications should be changed every fifteen or twenty minutes, never being allowed to become cold.

*Cold Irrigation.*—Should be used at least once in every case of colitis, normal salt solution being employed at 100° to 105° F. The solution should always be used warm, as it at times has a pronounced sedative effect when used in this way, and thus may fulfil two purposes. Whether the irrigation is repeated or not must depend upon its effect upon the patient. When he strains against it and there is no apparent diminution in the number of the stools, it should not be repeated. Frequently, however, the intestine remains quiet and the number of passages is diminished after a warm irrigation—105° to 110° F. In such cases it may be repeated twice daily. In cases in which there is not an active bowel action, and decomposing blood and mucus are removed by the washing, it may be used once or twice daily.

Only in the rarest instances, when there is high fever and bowel action is delayed, should intestinal irrigation be practised oftener than once in twelve hours. This treatment is often overdone. Irrigation should always be used for a definite purpose, and discontinued when that purpose is accomplished. Every year, at the close of the heated term, one sees cases of chronic colitis without fever which are being treated by irrigations two or three times daily without any indication for the irrigation other than the mucous stools. Irrigations, without question, help to keep up the secretion of mucus, for repeatedly it has disappeared entirely in a few days without other treatment after the discontinuance of the irrigation. When irrigation is practised frequently in cases with inactive peristalsis it is possible to produce a general edema due to the absorption of the fluid. This has been done experimentally in well children.

*Starch and Opium.*—The time-honored remedy—the injection of starch and opium—may be of service in the cases in which there is much tenesmus, with the passage of small amounts of blood-streaked mucus or the discharge of bloody mucus from the rectum. In these cases the principal lesions are usually located in the sigmoid and rectum. A straight-pipe, hard-rubber syringe answers best for this purpose. A starch solution of the strength of 1 dram of starch to 1 ounce of boiled water is used. For infants under one year of age 5 drops of laudanum may be added to 2 ounces of the starch solution, and repeated at intervals of six to eight hours. Older children may be given from 8 to 12 drops of laudanum with 4 ounces of the starch solution, and this may be repeated in four to six hours.

Improvement in the colitis is indicated by a subsidence of the temperature, a change in the character of the stools from green or clear mucus, with blood and scarcely any odor, to passages which gradually take on a fecal odor and show the presence of feces mixed with mucus.

*Infusion and Transfusion.*—In cases that are doing badly, in which exhaustion and dehydration are marked, transfusion is of great service. If this is not possible, hypodermoclysis or intraperitoneal injection of normal salt solution may be employed (pp. 850-851).

*Serum Therapy.*—The use of antidyenteric serum and solutions of

bacteriophage or bacteriolysin is theoretically rational and is advocated by many workers, but thus far the results in general have not been particularly striking. Further advance in the treatment of dysentery will probably be along the lines of serum therapy, or from further knowledge of the mechanism of the D'Herelle phenomenon. Practical results thus far do not warrant further discussion here.

*The Influence of Climate.*—When the case is under control, a change of climate is most beneficial. A child who has had colitis at the seashore or in town will invariably have recovery hastened by a removal inland to the mountains, where an open-air life is to be insisted upon.

*Diet in Convalescence.*—With a subsidence of the fever and an improvement in the number and character of the stools the patient's troubles are not over. The problem of nutrition is often difficult. The child has necessarily been on a reduced diet for several days—often for two to three weeks. If better nourishment than cereal gruels and protein milk is not soon forthcoming, the patient faces the danger of malnutrition and marasmus, which is the outcome in not a few of the badly treated cases in which the disease is not quickly fatal. The use of fresh milk must sooner or later be attempted.

In nearly all these cases the child has not been getting sufficient caloric units for maintenance of weight. This applies particularly to children, who, on account of age or refusal to take it or intolerance, have not had the benefits of protein milk.

Children who have had colitis bear fat badly. The younger the child, the more certainly is this the case. This has been so forcibly impressed upon the writer that he has discontinued attempts at feeding these convalescents, even with small quantities of whole milk. They do best on a carbohydrate gruel as a basis of diet, to which sugar-of-milk is added in the proportion of from  $\frac{1}{2}$  to 1 ounce to the pint, thereby furnishing material for heat and energy. To this sugar-cereal combination boiled skimmed milk in small quantities is added; not over  $\frac{1}{2}$  ounce, and that to only one of the feedings, the first day that milk is given. If this causes no inconvenience, an increase of  $\frac{1}{2}$  ounce is made at every second feeding the following day, and an increase of  $\frac{1}{2}$  ounce at every feeding the third day. The total quantity of food given at each feeding is to remain the same, an equal quantity of the cereal diluent being removed to make way for the milk increase. Thereafter, if all goes well, an increase of  $\frac{1}{2}$  ounce is made in each feeding every day until the child is taking his daily feedings of skimmed milk one-half strength. In some cases it may be found that the child's capacity will be only 2 ounces of skimmed milk at a feeding with the cereal-water diluent. Here he must be held, perhaps, for a week or two before milk can safely be advanced. Usually the younger the child, the more difficult will be the resumption of the milk diet. After the first year the nutrition may be assisted by thick gruels of varying types and compositions, zwieback, bread crusts, or rare scraped beef—two or three teaspoonfuls daily, with a couple of feedings of protein milk or buttermilk. By infants under one year of age who cannot take even a weak dilution of skimmed milk, Granum No. 1 (p. 95) will usually be well taken. If there is abdominal distention from starch indigestion the Granum may be dextrinized. Cereal-water also answers well as a

diluent for evaporated milk. In adding evaporated milk to the cereal-water sugar is to be omitted. The evaporated milk may be increased slowly until from 1 to 4 drams are given at a feeding. Under no ordinary considerations, however, should this diet be permanent. After from two to four weeks the use of plain milk should be attempted, replacing one feeding of the evaporated by a small amount of diluted plain milk.

Obstinate constipation sometimes follows recovery from severe ileocolitis. This is to be managed along the lines laid down for the management of constipation (p. 267). Following an attack of ileocolitis the patient must never be allowed to pass twenty-four hours without an evacuation of the bowels. A standing order should be given that an enema should be used when no movement occurs.

### CHRONIC ILEOCOLITIS

Cases of chronic ileocolitis coming under our observation have invariably been preceded by acute attacks that were unusually severe or that were badly managed. These cases represent one of the forms of malnutrition, but are of such a nature as to require special consideration.

**Pathology.**—The walls of the intestines are thickened with connective-tissue formation, and the solitary follicles have undergone pigmentation as a result of hemorrhages or extreme congestion.

**Symptoms.**—The patient is emaciated, and often 3 or 4 pounds under weight; the skin is dry and rough; the circulation is poor; the extremities are cold, and the temperature is often subnormal, showing an occasional sharp rise. The abdomen is always distended with gas. The stools usually are loose, number three or four daily, and contain mucus in considerable amount. The mucus may be absent for two or three days; then there will be a rise in temperature of from 102° to 105° F., and large quantities with a very foul odor will be passed. The nervous symptoms are usually marked. The child is irritable and sleeps poorly. He cries a great deal, is very unhappy, and looks as wretched as he apparently feels.

In assuming the care of one of these cases it is well to inform the parents that a rapid improvement is not to be looked for.

*Illustrative Case.*—A patient aged three and one-half years, who eventually recovered, weighed but 23 pounds—2 pounds less than when she was eighteen months old. During the first six months of treatment there was very slow improvement in spite of every advantage that care and change of climate could afford.

**Treatment.**—The management consists in a proper diet, change of climate when possible, and supportive measures. It is for the physician to find out in a given case what means of nutrition are best. These cases vary considerably in their digestive possibilities, with the exception that they all bear fat foods badly.

**Diet.**—Chronic colitis is very fatal in young infants, and but few survive. By far the best food for infants under one year of age is breast milk, which at first must be given in small quantities. Sugar-water should be given before the nursing. These young infants do not do well on starchy foods unless they have been dextrinized (p. 95); and when predigested they may have too laxative an effect, and should be given in

small quantities. The use of starch, therefore, in these cases, for a considerable time at least, is limited.

Standard protein milk and buttermilk have failed the writer repeatedly in feeding these young children. It is the improved protein milk (p. 89) that has given the best results in such cases. The patient may be able to digest the unsweetened condensed milk in the proportion of 1 : 6 to 12 of water or weak gruel diluents. Two or three feedings a day may be given in alternation with a dextrinized gruel. The addition of  $\frac{1}{2}$  ounce of gelatin to the pint of food makes a desirable addition to the feeding of malnutrition cases in which food of low caloric value is necessary.

The beaten white of egg may be given in diluted skimmed milk or in dextrinized gruel No. 3 (p. 95) if it agrees, or in plain water with salt added. The whites of two or three eggs may thus be given daily with benefit. For older children, after the first year, skimmed milk, protein milk, rare scraped meat, junket, and coddled white of egg are usually best. Zwieback or bread crusts may be given in small quantities. Alcohol, if given at all, should not be long continued. It is well to feed these patients five times a day at four-hour intervals.

There should be a standing order for an enema after an interval of twenty-four hours if no bowel movement takes place during that time. Absence of bowel movement in these cases almost invariably is followed by fever, prostration, and perhaps convulsions. If there is a tendency to constipation, some laxative, such as magnesia, mineral oil, or the aromatic fluidextract of cascara, should be given daily in sufficient amount to insure at least one free evacuation.

Irrigation of the colon is not to be used as a routine measure. It is indicated whenever there is a rise in temperature, even though the bowels have moved but a few hours previously. A laxative, preferably castor oil or calomel, should also be given.

The further treatment calls for salt baths, oil inunctions, and the open-air life referred to in the section on Malnutrition, p. 146.

### MUCOUS COLITIS

Mucous colitis is a chronic catarrhal condition of the colon, characterized by the production of very large quantities of mucus. The mucus forms a pseudomembrane over the mucosa, and is passed in the form of casts or large worm-like masses.

Attention has elsewhere been called to the necessity, in dealing with some of the diseases of children, of ignoring what appears to be a local manifestation of disease, and treating the patient along dietetic and hygienic lines. This necessity is in no instance better illustrated than in the case of mucous colitis, a disease fortunately rare in children, yet of sufficient frequency to warrant our attention.

**Etiology.**—The patients treated have invariably been of a pronounced neurotic type, usually of neurotic ancestry, and invariably from a neuropathic environment. It is quite usual to find that a considerable quantity of milk has been taken daily. Ptosis of the transverse colon and the elongated or ptosed sigmoid (p. 255) may be in part responsible for some of these cases.

**Symptoms.**—The disease rarely follows an acute inflammatory process in the intestine. In the majority of instances there is a history of obstinate constipation in a markedly neurotic, underfed child. Constipation may have existed during the patient's entire life. Almost without exception the treatment which has been followed has consisted in the use of colon irrigations and various kinds of astringents, such as solutions of tannic acid, nitrate of silver, etc. In children with mucous colitis the appetite is capricious, the bowels are usually constipated, and the disposition is chronically irritable. These children are apt to complain of ill-defined pains in the abdomen, which are never very severe and are not necessarily associated with the taking of food. There is usually slight generalized abdominal tenderness. A child four years of age, however, whose case was the most pronounced ever under our care—never had the slightest evidence of pain of any character. With the dejections there is usually mucus in considerable amount, which is occasionally passed in large masses, at other times in long, tenacious strings, sometimes referred to as "ropy." During a period of several consecutive days little or no mucus may be passed; then large amounts will suddenly appear.

**Treatment.**—These cases respond most quickly when local measures which often are irritant to the intestinal mucous membrane are discarded. Usually, as a result of previous treatment and because of the nature of the disease, the constipation is most obstinate. To prevent this an injection of 2 to 3 ounces of olive oil is employed at bedtime, the tube being introduced 8 inches into the bowel. After breakfast on the following morning the child is placed at stool, and if no passage occurs within fifteen minutes, a glycerin suppository is inserted. By this means one passage daily is insured, and this, ordinarily, is all that is required. The use of the suppository is to be discontinued after a very few days, as soon as the habit of evacuation at a certain time is established. Should this method fail, from 1 to 2 drams of the aromatic fluidextract of cascara may be given in addition, at bedtime, this medication being gradually diminished and discontinued as soon as it is demonstrated that an evacuation will occur without medication. A remedy of considerable value is the liquid petrolatum given in dosage of  $\frac{1}{2}$  ounce to 2 ounces at bedtime, and continued in gradually diminishing doses until the stools are free. Local measures other than those suggested for constipation are not to be employed.

**Diet.**—Not infrequently these patients have been taking a considerable amount of milk. This is to be immediately discontinued. In its place malted milk or whey may be given. The further diet consists of whole-wheat bread, animal broths, cereals cooked three hours, eggs, poultry, red meat, stewed fruit, and fruit juices. Spinach, stewed carrots, and asparagus-tips are the only vegetables allowed at the beginning of the treatment, and these by no means should always be given. Purée of peas, beans, and lentils may be given freely. The use of butter is to be encouraged in amounts up to 3 ounces daily. It may be given on bread or on the cereal.

**Drugs.**—Strychnin and nux vomica appear to exert a very beneficial influence on these cases. The combination of nux vomica and quinin has

been very satisfactory. For a child from five to ten years of age the following may be ordered:

R. Tincture nucis vomice..... gtt. xc  
 Quinine bisulphatis..... gr. lx  
 M. div. in capsulas No. xxx.  
 Sig.—One capsule after each meal.

A child suffering from mucous colitis invariably shows a considerable degree of malnutrition. For details respecting sleep, rest, exercise, and baths, all of which are more important than medication, the reader is referred to the section on Tardy Malnutrition (p. 146).

#### DEVELOPMENTAL ABNORMALITIES IN THE INTESTINAL TRACT AS A CAUSE OF DIGESTIVE DISTURBANCES

As stated on page 221 observation with the Roentgen ray in association with constant clinical supervision has opened up an entirely new field in the etiology of persistent intestinal disorders in children.

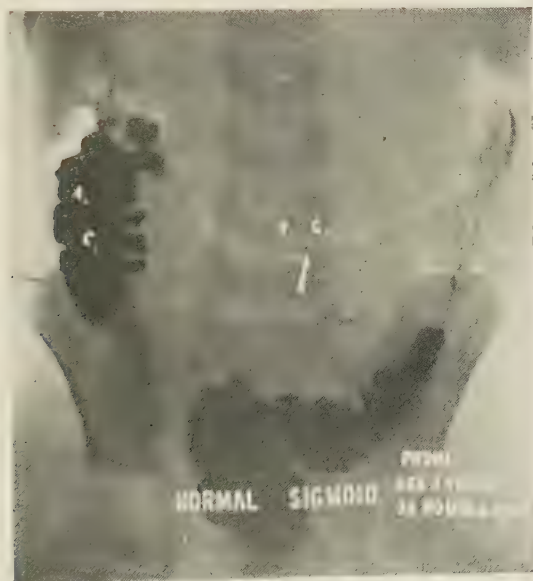


Fig. 42.—Normal sigmoid in a child of three years.

Due to abnormalities in structure and in the relations of various portions of the intestine there results a derangement of function with disturbed physiologic and chemical processes which makes for faulty nutrition, defective growth, and inferior general development of the child, both physical and mental.

Mechanical defects of the intestine, such as ptosis of the colon, dilatation of the colon, dilated cecum, and the long sigmoid are the abnormalities most frequently encountered. The ptosed colon is usually associated with dilatation and ptosis of the stomach (p. 221) and is probably secondary to that condition. Conversely, one of the most interesting

facts brought out in our x-ray studies is the dependence of stomach retention upon irritation somewhere in the lower bowel.

The "gradient idea" of Alvery<sup>1</sup> fits these cases admirably. Children with stomach retention of this particular type have almost every form



Fig. 43.—Female aged nine years. Elongated sigmoid passing above level of transverse colon (LeWald).

of gastric manifestation, and their histories of loss of appetite, belching, vomiting, and pain, either paroxysmal or constant, mild or severe, and at

<sup>1</sup> Mechanics of the Digestive Tract, Hoeber, 1922.

times gnawing, in character, have so impressed us that our first thought in treating a disorder of the stomach is to attend to proper intestinal elimination. In several cases later to be mentioned periodic vomiting

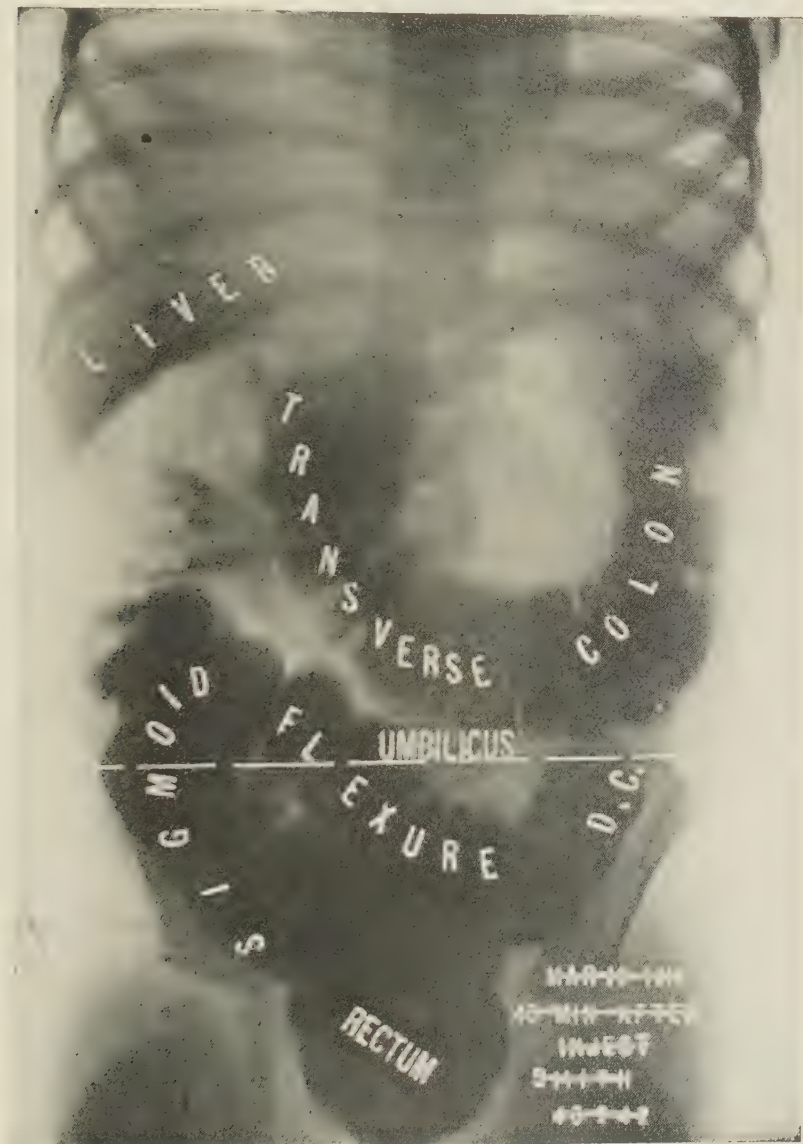


Fig. 44.—Female aged two and one-half years. "Double-barreled" transverse colon. Appearance due to elongated sigmoid flexure passing across to right side of abdomen and above crest of right iliac bone (LeWald).

was entirely relieved by curing rectal constipation, a result obtained in one instance by stretching the sphincter ani. Many children have been relieved by the correction of other abnormalities.

We shall have much to say upon the abnormalities of the large intestine. Figure 42 shows what may be looked upon as an anatomically normal large intestine. It is appreciated that there are always variations in the normal; only those showing gross abnormalities will be discussed.

**The Elongated Sigmoid.**—The most frequent abnormality consists in an elongation of the sigmoid (Figs. 45-46), which may be from two to four times the length given as normal in works on anatomy. This anomaly is of congenital origin. It is stated that such elongation always causes symptoms. Much depends upon the size of the pelvis and whether there are associated dilatations and sacculations. That there are children with markedly elongated sigmoids who are in no way inconvenienced is fully appreciated, but whether they will go through life without trouble



Fig. 45.—Three minutes after injection—redundancy of sigmoid amounting to about three times average length. Appendix partly filled.

is another question. The fact remains that when attention is directed toward relieving whatever fault may be occasioned by the deformity, the patient with rare exceptions makes a very ready response.

The following illustrations together with the accompanying case notes are intended to present this subject more concretely.

The history of the case represented in Fig. 43 is as follows: A girl aged nine years and weighing 54 pounds showed hemoglobin 40 per cent. and red blood cells 4,000,000. She was of delicate appearance, and made very slow gain in weight. About every two months she had so-called bilious attacks simulating recurrent vomiting and accompanied by high fever so that she was in bed for several days with each attack. The bowels were habitually constipated and daily laxative medication was required. The breath was offensive. The Roentgen ray revealed ptosis

of the stomach and showed that the organ failed to empty itself in seven hours. There was also marked ptosis of the transverse colon and marked elongation of the sigmoid.



Fig. 46.—Male aged three and a half years. Elongated sigmoid. One of the most extreme types encountered. (LeWald.)

Figure 44. A girl, aged two and one-half years, weighing 25 pounds and giving evidence of moderate malnutrition, showed hemoglobin 55 per cent. and red blood cells 4,600,000. She had had three convulsions of gastro-intestinal origin in the previous year. For her habitual consti-

pation medication or an enema was required daily. The urine showed a moderate amount of acetone. The Roentgen ray revealed an elongated sigmoid passing 2 inches above the umbilicus. When the child was in the prone position the sigmoid passed to the right as far as the lateral abdominal wall.

Figure 45. A girl five years of age was subject to repeated attacks of vomiting and obstinate constipation, the vomiting seizures occurring about every two months, continuing two or three days, and leaving her



Fig. 47.—An elongated colon which had assumed a spiral form to adjust itself to the pelvic capacity. The sigmoid is also greatly elongated and there is marked lengthening of the colon to about four times its normal length. The patient, a girl three years of age, but recently came under observation because of repeated vomiting seizures, occurring about once a month, lasting from twenty-four to thirty-six hours, and accompanied by convulsions and high temperature.

much reduced and weak. It will be observed that the sigmoid in this case is about three times its normal length.

Figure 46. A boy, three and one-half years of age, weighing 32 pounds showed a markedly elongated and prolapsed sigmoid.

The history given by the mother was substantially as follows: "The boy has had acute gastro-intestinal attacks since birth, with vomiting, diarrhea, and fever, acute seizures lasting three to four days during which he loses a pound or two of weight. During the past year two months have not elapsed without such an illness. Between attacks he is constipated and requires medication. He has frequent pains in the abdomen.

Appendicitis has been diagnosed. Some of these seizures have been diagnosed as colitis attacks because of the passage of considerable quantities of mucus. He is irritable and very unhappy in disposition. His breath is habitually offensive; his tongue habitually coated, and his abdomen is distended a greater part of the time."

**The Dilated Cecum.**—The dilated colon and cecum appear to be dependent upon the accumulation of feces and gases brought about by the obstruction occasioned by the long sigmoid, with its angulation and defective peristalsis.

Figure 48 represents the case of a boy thirteen years old who for six years had had severe attacks of pain definitely localized in the right lower quadrant. At first the seizures occurred only at intervals of three

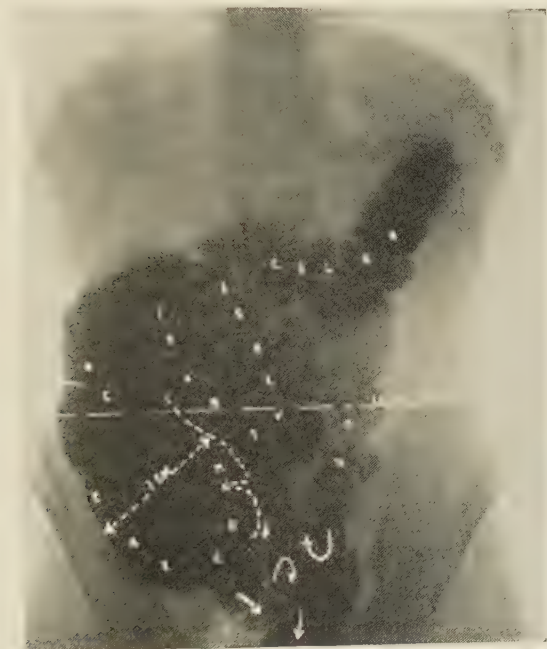


Fig. 48.—Dilated cecum and V-shaped colon in a boy of thirteen years.

or four months, but later every few weeks. He had no vomiting or constipation and only a moderate amount of nausea and anorexia, and this only at the time of the pain attack. The case had repeatedly been diagnosed as one of appendicitis. No point of tenderness could be discovered, and between the attacks no tenderness demonstrable by manipulation or otherwise. Blood examinations had been made repeatedly and were always negative. There was moderate abdominal distention at the time of the attacks. This boy was large for his age and well nourished.

The illustration shows the cecum so large that its shadow overlaps that of the sigmoid flexure and passes quite to the median line. The dilatation was probably secondary to retention produced by the V-shaped colon also shown in Fig. 48, the distention being the result of the back-up

or reverse peristalsis. The boy was given a simple diet of three meals daily, and liquid petrolatum in 2-ounce doses for several months. There had been no subsequent attacks of colic in the succeeding two years. The senior writer has had 5 cases of this nature with symptoms almost identical. It would seem beyond doubt that we have a definite clinical entity to deal with.

**Symptoms.**—The symptoms referable to the above abnormalities are repeated attacks of acute indigestion with cyclic or recurrent vomiting, abdominal distention, habitual or intermittent, intestinal colic, constipation which may be extreme, diarrhea alternating with constipation, or habitually loose mucous evacuations, and periodic fever with intestinal manifestations.

In addition to these active manifestations the patients are usually anemic showing secondary malnutrition. Their mental equilibrium is easily disturbed, they are apt to be unhappy irritable children, they sleep poorly and their appetite is capricious. A few show defects in stature. That arrested growth and anemia may be the result of abnormal intestinal function is readily understood when one realizes what a vital part the intestine plays in growth and development.

Constipation alone, or with abdominal distention, is present in nearly all cases. In those with diarrhea or habitually loose mucous evacuations there is always a history of previous constipation, and the relief of the constipation is the keynote of the management.

**Treatment for Constipation.**—The selection of suitable food for a given case plays a large part in the management. For the constipation the following dietetic regulations are advised: White bread, toast, and crackers are omitted. Oatmeal, cornmeal, hominy, cracked wheat, and the coarse cereals are allowed. Potatoes, rice, milk, and eggs are given sparingly. Milk is often replaced by malted milk. Green vegetables are given twice a day. Stewed or raw fruits are given the preference as desserts. Fresh meats and fish are allowed. Whole wheat bread and oatmeal crackers are recommended. Raw fruits are given with the stomach supposedly empty, an hour to an hour and a half before meals. We have found such giving of raw fruits with the stomach empty one of the most valuable dietetic aids in managing constipation. We are speaking now of those cases without stomach involvement.

**Enemata for Temporary Purposes.**—An enema may be employed, but it should never be given habitually. Marked dilatation of the rectum exists as a result of frequent enemata.

**Massage.**—Properly applied, daily massage is almost indispensable in obstinate cases. Massage and suitable diet may have to be continued for several months.

**The Abdominal Belt.**—Abdominal support of some sort is always of assistance in these cases. The writer has used the Aaron belt with an adjustable shelf, the Bassler belt, and in those cases with lordosis and a protuberant abdomen, a Universal Supporter (Lentz & Company, Philadelphia).<sup>1</sup>

**Medication.**—Olive oil and liquid petrolatum are useful in connection with other laxatives, but rarely sufficient when used alone. What is

<sup>1</sup> The latter device promises well. We have employed it in about 30 cases, but are not ready to pass upon its utility.

required is an active peristalsis. In using laxatives, however, care is to be exercised to avoid purgation. Our best results have been obtained by the use of aromatic fluidextract of cascara given three times daily after meals in doses sufficient to produce one or two free evacuations daily. With the aid of massage and the oil the cascara may be gradually reduced. It should always be given after each meal no matter how small the daily dosage.

**Treatment for Diarrhea.**—The child with diarrhea or with habitually loose evacuations, perhaps but one or two daily, is best treated by omitting stewed fruits and green vegetables entirely from the diet. Milk given these patients should be skimmed and boiled. The writer's earlier results with this type of case were very satisfactory. Two cases under treatment at the time of this report, in both of which the sigmoid is greatly elongated, are, however, proving intractable and not much progress is being made with diet and medication. Surgical procedures may be required in these cases.

Although there may be a displaced colon or an elongated sigmoid, and a history of previous constipation, the stool should always be examined in case of diarrhea for other possible causative factors.

#### HIRSCHSPRUNG'S DISEASE (IDIOPATHIC DILATATION OF THE COLON)

Two varieties of Hirschsprung's disease are recognized—the congenital and the acquired.

The condition is rarely encountered in its typical and extreme form. Only two well-marked cases have come under our observation. There is an enormous dilatation and hypertrophy of the colon without constriction. The greatest dilatation is found in the transverse and descending colon. In the cases described by Hirschsprung there were ulcerative processes in the mucous membrane and submucous abscesses.

**Etiology.**—In all cases the condition is probably based upon congenital structural defects.

**Symptoms.**—The prominent symptoms are obstinate constipation, symmetric enlargement of the abdomen (Fig. 49), and malnutrition.

The bowels may act only once in three to six weeks. Complete obstipation of two or three months' duration has been reported (Cautley). Respiration is often impeded because of pressure on the diaphragm. For a like reason the heart action may be interfered with. The hepatic and splenic dulness is obliterated.



Fig. 49.—Hirschsprung's disease.

**Prognosis.**—The prognosis for a complete cure is unfavorable. The patient usually succumbs to intercurrent disease.

**Treatment.**—Little is to be expected from treatment, whether medical or surgical. Various operative procedures have been attempted. The radical operation involving complete removal of the colon has been per-



Fig. 50.

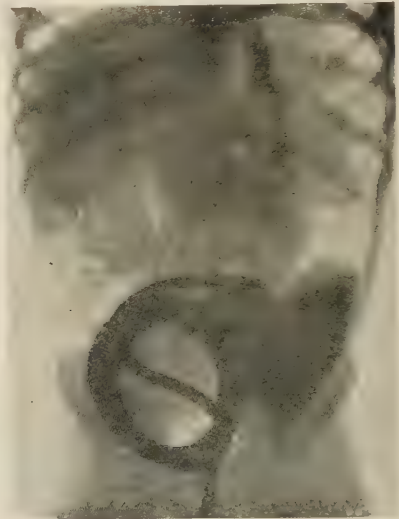


Fig. 51.



Fig. 52.

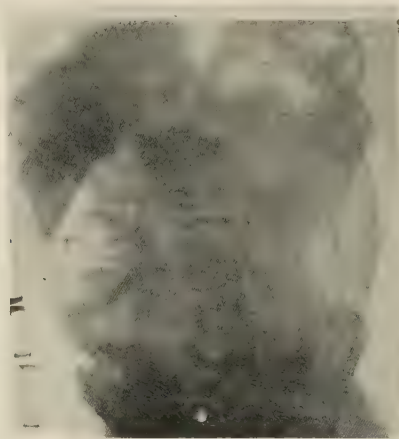


Fig. 53.

Figs. 50-53.—Megalocolon, dilated sigmoid, and markedly distended abdomen.

formed. As long as it is possible to produce an evacuation of the colon the patient may remain in a fairly comfortable condition. Laxative drugs, massage, electricity, and colonic irrigations may all prove useful as temporary aids.

The following case notes together with Figs. 50-53 illustrate the problem presented by a case of this type:

Male, aged seven years. Since birth extreme constipation. At eight months sigmoidopexy for prolapse of rectum, at which time dilatation of the colon with adhesions was noted.

*Roentgen Examination.*—Enormously dilated hepatic, splenic, and sigmoid flexures (Fig. 50), the sigmoid having a pouch-like appearance. Bilateral eventration of the diaphragm.

*Operation.*—Many adhesions about the sigmoid divided.

*Roentgen Examination.*—Twenty-two months later sigmoid greatly reduced in size. A tube instead of another injection was used to demonstrate this reduction, for the previous injection required two weeks for elimination (Fig. 51).

*Comment.*—Six years later physical condition excellent. Treatment had consisted of an injection of 8 ounces of warm water upon rising, followed by ten minutes of exercises. An abdominal belt had been worn. Roentgen examination showed that the splenic flexure, descending colon, and sigmoid had been converted into a uniformly dilated tube as a result of the operation (Fig. 52). *The entire injection was evacuated in forty minutes* (Fig. 53).

## CELIAC DISEASE

In 1888 Gee described a disease of unknown etiology which has since been established as a clinical entity. Children with this disease closely resemble each other in almost as many points as those who are Mongolian idiots. Diagnosis can always be made by inspection. The face is thin and usually pale, but not drawn and weakened, as in the usual form of malnutrition of gastro-intestinal origin. The abdomen is distended with gas and has a doughy feel, the distention varying in different cases and at different times of day. In those in which there is marked distention the abdomen may be quite flat in the early morning and yet the size may progress with the day so that when the child retires the abdominal circumference will perhaps measure 3 or 4 inches in excess of the morning measurement.

Taylor<sup>1</sup> has called attention to the fact that this disease has never been recognized in a breast-fed infant, and from a review of 7 cases has deduced that "the best way to produce celiac disease is to feed a susceptible child throughout the second year on a diet rich in milk, fat, and potato, and then to subject him to some parenteral infection." In all of the cases of Taylor's group the liver was smaller than normal, and in all of 5 cases examined gastric achlorhydria was present.

**Etiology.**—The age at onset is variable. The writer's youngest patient was nine months, and the oldest two years and eight months of age. Some of the patients gave a history of difficult feeding which, as a rule, meant cow's milk incapacity, and in many instances the case only gradually took on the characteristics of celiac disease. Other cases are typified by the child represented in Fig. 141, p. 802. He was a strong vigorous boy until thirty-two months of age, and then had a sharp attack of diarrhea followed by the chronic intestinal disturbance.

**Symptomatology.**—In this disease the muscles of the entire body undergo atrophy. This is particularly noticeable in the arms and legs, in which the muscles are very small, flabby, and weak. The knees and feet are prominent and appear abnormally large. Muscular atrophy and muscular weakness is a comparatively early and very prominent sign and a condition slow to be recovered from when the child begins to improve. All evidence of normal nutrition is lacking and growth in height ceases. The patient may not increase an inch in height while the disease is active.

<sup>1</sup> Celiac Disease, Amer. Jour. Dis. Child., vol. 25, January, 1923, p. 46.

In one case height was absolutely stationary for two and a half years, and at the end of this time the weight was 6 pounds less than at the outset. If the child has walked he soon loses the ability because of muscle weakness, and he is habitually irritable, sleeps poorly, demands entertainment and is not satisfied when it is supplied.

The enlarged abdomen often gives rise to the diagnosis of abdominal tuberculosis and the stunted growth causes confusion in differentiation of celiac disease from the infantilism of Herter (p. 266). Hirschsprung's disease also presents a similar train of symptoms. In both these conditions, however, there is a definite pathology. In the true cases of infantilism the child remains a dwarf (see descriptive case, p. 266).

Our patients with true celiac disease have recovered with the exception of a small proportion. Those recovering have in every way taken their place in the world with others of their age. That such individuals are permanently shorter in stature than would have been the case had the celiac disease not handicapped them, has not been proved by the few that have been followed to adolescence.

These patients have another feature in common, persistent bowel derangement. The character of the stools is the same in all cases and is in itself diagnostic. The stools are loose, watery, sour, glistening, and usually foul, and of a greenish color, often presenting a spongy appearance as though undergoing fermentation. Occasionally there are periods of constipation, but this is not usual. Chemical examination shows the presence of fatty acids, unchanged fat, starch and mucus, the findings depending, of course, upon the nature of the food ingested. During the same year two patients under observation have developed a very obstinate tetany, and one of these had two attacks of scurvy on account of incapacity for food containing the antiscorbutic vitamin. Both patients were between four and five years of age. One died from exhaustion and starvation while the tetany was active. The other when well on the road to recovery required treatment for postural defects caused by the prolonged illness and associated muscle weakness. Death in the writer's cases has been due to acute exacerbations of the chronic diarrhea or to inanition.

**Management.**—Internal medication has been of no service. We have given these children ductless glands, yeast, calomel in minute doses, pancreatic extract, and all sorts of so-called intestinal antiseptics, all without avail. The first step of value is to omit cow's milk absolutely from the diet, the writer's experience having convinced him that milk is inadmissible in every case whether in the form of skimmed, evaporated, fat-free, protein, or dried milk. During the past year he has used in 10 cases a synthetic milk which promises well. It is prepared by the Walker Gordon Laboratory according to the following formula:

Casein.....	4 per cent.
Sugar.....	4 “
Starch.....	6 “

One quart is usually ordered, and to this 20 grains of calcium chlorid is added. In addition to this the child is given the usual diet for the age inclusive of starches, but with perhaps a lessened amount of green vegetables and with the omission of raw fruit temporarily with the exception of

ripe banana.<sup>1</sup> The giving of orange juice should always be attempted even though the amounts are small. Occasionally a child will not take the synthetic milk. In such instances it is necessary to establish the child on a milk-free diet. Those who take the casein milk thrive much better than others. In providing this we give nitrogen, calcium, and soluble and insoluble carbohydrates, and thus establish a nutritional foundation, which is most valuable. No trouble has been experienced in giving starch if fresh milk is omitted.

Another measure which we believe has a future is the use of the abdominal support. For the past three or four years the writer has used for this purpose some form of belt, chiefly those types advocated by Aaron and Bassler. During the past year the universal supporter (Figs. 142-144) of Nicholson has been used for patients over two years of age. The results with this were so satisfactory in one case (p. 802) that the appliance seems highly worthy of a wider use. This support, however, is not applicable for very young children.

In every case of celiac disease with enlarged abdomen some form of support is of undoubted assistance.

When the patient has recovered, several months will be required before he learns or relearns to walk. Still has reported a case in which a child did not walk until he was six years old. The usual muscle stimulants, among which massage is of foremost value, will help to restore the muscles in these cases.

Johnson<sup>2</sup> has suggested that celiac disease represents a true milk allergy.

We agree with him that the clinical observations would indicate an allergy to a marked degree. It is generally accepted that although the positive skin test usually is lacking in these cases, this test is not the last criterion of protein sensitization. A vast amount remains to be learned on this subject regarding degrees of sensitization. It has appeared that imperfect metabolism of fat with the formation of fatty acids may be productive of toxic agents inducing temporary dysfunction. That such may be the case and that whatever injury is produced simply relates to function is shown by the health and vigor of the children who recover.

*Illustrative Cases.*—*Case 1.*—A child who had been through the hands of a half-dozen or more of the best pediatricists in the country showed not a particle of improvement until the synthetic milk was instituted and the fresh cow's milk in every form eliminated.

*Case 2.*—A typical case of celiac disease with a satisfactory outcome is the following: S. McG., a boy three years and nine months old, had been ill from the twelfth month with persistent gastro-intestinal indigestion. About six months previous to coming under observation he had undergone operation for Pott's disease by Dr. Russell Hibbs, of New York City.

At that time the boy's weight was 21 pounds, 11 ounces, and he showed every characteristic of celiac disease; small flabby muscles, a greatly enlarged abdomen, inability to walk, and characteristic stools. Cow's milk including protein milk had been given in some form by the various pediatricists who had attended him, the dietetic methods varying in other respects. A new diet was given consisting of 1 quart of the synthetic milk daily and an ordinary allowance of starches, meat, and vegetables. As soon as the cow's milk was discontinued the stools became dark and formed and

<sup>1</sup> A few years ago Dr. Sidney Haas, of New York, called the writer's attention to the use of banana in celiac cases, and a free use of this fruit has since verified the statements made as to its desirability.

<sup>2</sup> New York State Journal of Medicine, Chronic Intestinal Indigestion in Children.

lost the characteristic sour fetid odor and greasy appearance. At the end of the year the boy weighed 30 pounds, 5 ounces, and although 3 inches under height, he was well in all respects, walking, running, and playing with his brothers and sisters. The abdomen, however, still remained large.

### THE INTESTINAL INFANTILISM OF HERTER

Notwithstanding the great amount of scientific work accomplished by Christian A. Herter, it seems likely that his name will be perpetuated in connection with the condition of intestinal infantilism more than by any other work that he did, for he described a condition that was never before carefully studied and thus established it as a distinct disease with characteristic symptoms, intestinal flora, and changes in the urine (Freeman<sup>1</sup>).

In this disease there is an arrested physical development, the child is usually well formed, but does not grow and does not gain in weight. A female patient at seven and one-half years of age weighed 20 pounds and was 34½ inches tall. No growth had taken place since she was two years old.

A description of this child covers the symptomatology in all. The mental development was normal, the patient could read and write. In contrast to the small stature there was a marked enlargement of the abdomen. The patient was of low resistance—she tired readily and was peevish and unhappy. She had an enormous appetite and demanded food about five times a day. The stools were large and fatty in appearance and contained a large amount of fat and fatty acids.

In Herter's infantilism frequent attacks of diarrhea are the rule. The urine shows an excess of putrefactive products of intestinal origin; the indican and phenol compounds are present. The bacterial flora of the intestinal tract, according to Herter,<sup>2</sup> comprise Gram-positive organisms of the *Bacillus bifidus* type, *B. infantilis* type, and cocco-bacillary forms. There is a marked absence of Gram-negative bacilli in the stools.

Infants of this type are very discouraging patients. No pronounced improvement is to be expected from any line of treatment. Milk, rare meat and poultry, and cereals, such as oatmeal and the wheat derivatives, constitute the basis of the diet.

Freeman feels that he has observed benefit from the use of extract of pancreas, 3 grains three times daily in the form of an enteric pill. The attempt to implant a Gram-negative flora in the alimentary tract should be made. Cultures of *Bacillus acidophilus*, *B. coli*, and of *B. bulgaricus* may be given.

### INCONTINENCE OF FECES

Incontinence of feces is a normal condition during infancy, control being established without training during the second year or earlier. In well-trained infants we have seen the bowel function under perfect control at the third month. This is, however, unusual. With a very little teaching it may be accomplished at the sixth month. Incontinence of feces in older children occurs during acute inflammatory conditions, par-

<sup>1</sup> Jour. Amer. Med. Assoc., vol. ii, pp. 329-332.

<sup>2</sup> Herter's Infantilism, Macmillan Co., 1908.

ticularly when the colon is the seat of the lesion. Incontinence may also occur in asthenic states, as in grave pneumonia, in typhoid fever, and in the more severe types of the exanthemata; and it may occur accidentally as the result of fright, shock, or severe straining. It may result from spinal cord disease or injury, and is sometimes due to spina bifida, in which event the fecal incontinence may be compared to incontinence of the urine. We have seen 6 such cases. In 2 the condition had existed for months.

Incontinence of feces, as a condition independent of early infancy and illness, is of exceedingly unusual occurrence. Of 5 patients, 2 were boys, one four and the other seven years of age. In these 2 the condition had persisted for months. The desire for an evacuation came with great urgency and was uncontrollable. In 2 other cases there was occasional incontinence due to a relaxed sphincter, probably produced by frequent irrigations. These responded to the treatment outlined below. In the fifth case there was no response to any treatment instituted. The patient was a boy six and three-quarter years of age, and had suffered from the incontinence for a year and two months. He was under treatment for two weeks; no improvement resulted, and he passed from observation.

**Treatment.**—The treatment consisted in the removal of green vegetables and fruit from the diet, allowing only a small amount of starches, such as bread, potato, and cereals. Eggs, meat, skimmed milk, junket, custard, etc., were given freely. The medicine comprised 15 drops of the tincture of the muriate of iron in glycerin and water, given every four hours, with 1 grain of Dover's powder and 20 grains of subnitrate of bismuth given three times daily. Cases which do not respond promptly to diet and medication should have the advantage of surgical procedures.

## CONSTIPATION

Deficient fat content in the milk of young infants, and insufficient solid food in the diet of children over one year of age, probably are responsible for a majority of the cases of constipation. The digestive organs demand not only elements for assimilation, but a certain amount of food residue to act as a stimulus to perfectly normal musculature. The results of the absence of a fair amount of this food residue in the diet are most apparent in children between the first and third years, who receive over a quart of milk daily, administered in frequent instalments, and from force of parental habit or perverted desire on their own part are deprived of such important dietetic ingredients as cereals, vegetables, and fruit. Such children are almost invariably sufferers from chronic constipation.

The cases commonly ascribed to deficient secretion on the part of the intestinal glands and liver are also frequently of dietetic origin.

Mechanical defects and abnormalities may be entirely responsible for the most obstinate constipation. Localized proctitis, fissures and hemorrhoids, and sphincter spasm may be important causative factors. Congenital narrowing of the gut, elongated sigmoid (Fig. 45), prolapse of the colon (Fig. 55), hernia, and congenital dilatation of the colon (Hirschsprung's disease) deserve to be borne in mind in this connection.

As our experience with this disorder increases we are more and more

impressed with the importance of disturbed intestinal mechanics as a direct or accessory cause of constipation in children of all ages.

Before instituting treatment of any nature it is necessary to know that no mechanical cause exists.



Fig. 54.—Dilatation and stenosis of the rectum. (The appendix is outlined.)

Figure 54 represents a female child five years of age showing extreme retention in the rectum twenty-seven hours after a bismuth meal. The child came for malnutrition and with the diagnosis of acidosis. In very early life she was supposed to have had pylorospasm. There had been much trouble in feeding her up to time she was three years of age; and she had had frequent vomiting seizures with high fever— $103^{\circ}$  to  $105^{\circ}$  F. During her fourth year she had but two seizures of the fever and vomiting. This patient has but recently come under observation. Stretching the anal sphincter, abdominal massage, and a diet directed to relieve her constipation (p. 273) will be followed out in this case.

**Bowel Evacuation Necessary.**—In order to keep the infant or young child in good physical condition one free evacuation of the bowels is required once in twenty-four hours. While two or three evacuations daily may be desirable, this number is not absolutely necessary. When there are more than four passages in twenty-four hours the inference is that something is wrong with the intestinal tract. This, however, may not be of such a nature as to require radical means for its correction. Thus,

many nursing babies who are supplied with a high-fat breast milk, may have several thin greenish stools in twenty-four hours, and in spite of the condition thrive satisfactorily. It is well in these cases to attempt to reduce the fat in the breast milk by measures suggested elsewhere, but by no means should the nursing be interdicted if the baby is making a reasonable gain in weight. The proof of successful nursing is a thriving child, not the character of the stool. The habit of an evacuation at a certain time each day is one of the most important preventives of constipation in an infant. There should be a standing order in every household to the effect that the child is never to be put to bed for the night unless the



Fig. 55.—Prolapsed colon and anal sphincter spasm. The patient was a girl six years of age with a typical V-shaped ptosed colon and dilated rectum. The story was that of recurrent attacks of vomiting every six weeks. Enemata for the chronic constipation had been given daily since birth. Retention of the opaque meal was observed forty-eight hours after injection of the material. This child had also a moderate stomach ptosis. The anal sphincter was stretched under anesthesia. An Aaron belt with shelf was applied and the diet regulated. No attacks of vomiting occurred subsequently during observation extending over two and a half years.

bowels have moved during the preceding twenty-four hours. Either a simple soap and water enema or a small glycerin suppository may be employed. The enema is preferred, from 4 to 8 ounces of the soap-water being used. The suppository is to be used only when, for any good reason, the enema is not available. Placing the child at stool immediately after the morning bottle is one of the means of establishing the habit of an evacuation at a definite time each day. The child soon appreciates the reason for this practice and acts accordingly. This procedure may be begun when the child is five or six months of age.

**Defective bowel evacuation** in infants and young children is a form of

constipation very apt to be overlooked, and for this reason it is put under an independent heading. As long as an evacuation takes place daily it is supposed to be sufficient. Even though a passage takes place daily and voluntarily, if it is dry and comes away in pieces or in hard balls, or is firmly formed without the moist surfaces caused by the presence of mucus and water, it is practically certain that the evacuation is not complete and that fecal matter is retained in the intestine. This type of constipation is often associated with ptosis of the stomach (p. 221) and anal sphincter spasm. (See Fig. 55.) The ptosed stomach always empties very slowly and the absorption of the water from the intestinal contents is then more than normally complete. This may occur at any age, and when the condition persists, an intestinal toxemia may result with the manifestations referred to under Indigestion (p. 232). The same methods of treatment are to be followed as suggested for constipation at the various ages of infancy and childhood.

**Constipation in Nurslings.**—There are many nursing infants who are thriving and well in every respect, except that they are constipated. Bowel evacuation is greatly delayed or does not occur without aid. Our first step in the management of these cases is to examine into the daily life and habits of the mother. A factor in the etiology of constipation in the infant is constipation in the mother. Treatment of the mother will often relieve the child. If, however, the constipation in the mother is not relieved, the subsequent treatment directed toward the child will be much less effective. Nursing women who drink a great deal of tea are apt to be constipated, and their infants are similarly affected. The nurslings of mothers who lead indolent lives, taking but little exercise, are likewise sufferers from constipation.

*Treatment of the Mother.*—Errors in the mother's diet and habits of life must be corrected and the scheme carried out which is recommended under Maternal Nursing (p. 42).

When a proper régime for the mother has been established, the breast milk should be examined. While high protein may contribute to constipation, this factor is rarely a cause. Low fat, from 1.5 to 2.5 per cent., with normal protein is much oftener found to be present.

Often in such cases the fat in the mother's milk may be increased, if only temporarily, by the use of some form of alcohol, given with the meals. Wine, beer, ale, porter, or the liquid malt preparations may be given, the mother being allowed to make her own selection according to her taste. The free eating of red meats also increases the fat in the milk.

Several years ago a series of observations were made in the New York Infant Asylum relating to the effects of diet on breast milk. It was found that in some cases the fat could be increased from 1 to 2 per cent. by the addition of alcohol to the mother's diet. The value of many of the various galactagogues on the market depends, in all probability, upon the alcohol which they contain.

*Treatment of the Child.*—A very tight sphincter is the cause of constipation in a small proportion of nurslings; and before beginning other treatment in such cases the sphincter should be stretched by passing a protected index-finger into the rectum. As an aid to nutrition and as a laxative a valuable addition to the diet of the constipated breast-fed

infant, when the mother's milk is found weak in fat, is cow's milk cream,  $\frac{1}{2}$  to 1 teaspoonful of which may be given before every second nursing or before every nursing, according to the age of the child and the capacity for fat digestion. Children during the early months of life take pure cod-liver oil readily, and oil, like cream, may serve the double function of a food and a laxative. Establishing by careful instruction the habit of an evacuation of the bowels at a certain time every day is a valuable measure.

*Drugs.*—Drug giving is rarely necessary in treating very young children and should be resorted to only when other measures fail. In case drugs are necessary, those most useful ordinarily are the preparations of cascara sagrada. The aromatic fluidextract is palatable and may be given in sufficient doses to be effective once or twice daily. The milk of magnesia with equal parts of the aromatic syrup of rhubarb, given in doses of from 1 to 3 teaspoonfuls daily, is an agreeable and usually an effective combination. The liquid petrolatum, in 1- to 4-dram doses, acting as a lubricant, often gives surprisingly good results.

*Enemata and Suppositories.*—The use of water enemata and suppositories is not to be advised as a routine measure. The habit of depending upon them is readily established, the bowel, by their frequent use, becomes insensitive to stimulation, and in a few weeks they fail to act. Many mothers are thrown into a state of great distress when this stage is reached. When the stool is dry and hard and is passed with difficulty, the injection of 2 ounces of warm sweet oil at bedtime is of advantage. This is not intended to produce an immediate evacuation, but rather to act as a lubricant for the evacuation expected the following morning.

*Malted Foods.*—It is elsewhere advised that the nursing baby be given one bottle feeding daily. The malted proprietary foods are distinctly laxative to many children. When, in a nursing infant, a condition of constipation exists which is not relieved by careful regulation of the mother's diet, one feeding of malted milk daily, in the strength of 1 teaspoonful to an ounce of water, may be prescribed. Some children will not take malted milk of this strength, as the sweet taste is objectionable. In such cases it may be given weaker at the beginning, or it may be given in a milk mixture suitable to the age of the child. When it is used in this way there should be no addition of sugar. Malted milk or Mellin's food may be used in a quantity equal to that of the sugar previously employed in the formula.

*Massage* is a most valuable means of treatment of the constipation of older children, but for nurslings and the bottle fed of tender age, on account of the restlessness and crying, it is not always practicable, and to be effective should be given only by those skilled in its use. Therefore, unless the case is an extreme one, and all other measures have failed, massage is not to be employed in treating the very young.

*Constipation in the Bottle Fed.*—Before undertaking the treatment of constipation in any infant the rectum should be examined to determine the presence or absence of sphincter spasm (p. 276). In the bottle fed inactivity of the bowel is more easily managed than in the nursling, because, in dealing with the former, we are in a better position to adapt the food to the child's digestive peculiarities. As a rule, constipated bottle

babies should have a reasonably high fat—3.5 to 4 per cent.—and sugar up to at least 7 per cent. This rule, however, is open to exceptions; a few of the most obstinate cases of constipation that have come under our care have been fed on a very high fat, the constipation being due to fat indigestion. It is extremely rare to find a child who can digest day after day a milk mixture containing more than 4 per cent. of cow's milk fat.

*The Protein.*—Cow's milk casein, although probably the most fruitful factor in causing constipation in bottle-fed babies, nevertheless is necessary for the child's nutrition. A considerable reduction, such as may be obtained by giving a mixture of cream, sugar, and water, may relieve the constipation, but the child thus fed will suffer from a nutritional standpoint, and instead of being constipated may become athreptic, which is much worse. In not a few instances malnutrition has been observed as the result from cutting down the protein in the effort to relieve constipation.

The child's growth and development must never be held subservient to anything else. A child under six months of age will not thrive satisfactorily on less than 1 per cent. of protein as found in cow's milk. He is entitled to at least 1.5 per cent., and thrives best when this amount is given. The relief of the constipation can in almost every instance be accomplished by other means than a too great reduction in the protein—the most essential nutritive element in the infant's food.

Milk given constipated infants should always be raw, as cooking increases its constipating tendency.

*Laxative Agents in the Food.*—The simplest means of treating constipation in the bottle fed is by the employment of a laxative agent in the food, and when such an agent adds to its nutritive value, it serves a double purpose. Instead of water as a diluent, oatmeal-water No. 1 (p. 94) may be employed. The malted proprietary foods, such as Mellin's food and malted milk, are laxative to most children. Mellin's food is composed largely of dextrose and maltose, which are laxative sugars, and therefore may be used in place of sugar-of-milk or cane-sugar in the food mixture, for the purpose of relieving constipation. The presence of potassium carbonate in dextrose and maltose combinations also probably increases their laxative property. In some instances we substitute a feeding of malted milk with from 4 to 8 ounces of water once daily for the regular milk food, the quantity and strength depending, of course, upon the age of the child.

*Drugs and Local Measures.*—Dietetic measures should always be tried before drugs are resorted to. One or 2 teaspoonfuls of milk of magnesia in one bottle daily may be recommended as a temporary expedient in some cases. The magnesia may be of service until the condition is controlled by the diet. The aromatic fluidextract of cascara, in doses of from 15 drops to 1 dram, may be tried if success does not follow the use of the magnesia.

Water enemata and suppositories should be used only as temporary measures. Orange juice, 2 teaspoonfuls twice daily before feedings, is worthy of trial, and is of antiscorbutic value for children artificially fed. Sweet oil and the pure cod-liver oil may be also used in doses from 30

drops to 2 drams, three times daily, after feedings. Oils produce beneficial effects not only as laxatives but also as aids to nutrition. Acting purely as a lubricant, liquid petrolatum in dosage of 2 drams to  $\frac{1}{2}$  ounce, once daily after the evening meal, is of much service in many cases.

*Oil Injections.*—In case the stool remains hard and dry in spite of a trial of the above suggestions, an injection of 2 ounces of warm sweet oil may be given at bedtime every night, not with a view to inducing a passage at the time, but as a lubricant to the parts and as a solvent of the hard fecal masses.

**Constipation in Older Children.**—*Etiology.*—Probably the most potent dietetic factor in causing constipation in children of the “runabout” age is the use of abundant milk, crackers and dry bread-stuffs. Particularly is this apt to be the case if the milk is boiled. Constipation at this age may also be occasioned by too great concentration of the food, insufficient volume being furnished to produce copious evacuations.

*Local Causes.*—In a great majority of children the freer feeding following weaning from the breast and bottle relieves the tendency to constipation from which many suffer during the earlier months of life. In a small percentage of cases, however, such relief is not furnished, and the child will require the attention of a physician. In making the physical examination of a case of this nature, special care should be directed toward the examination of the rectum, in order that local causes, such as fissures, hemorrhoids, or sphincter spasm may be eliminated. If fissures are present, the child will use every effort to prevent a bowel movement.

*Mechanical Obstruction.*—Elongation of the sigmoid (p. 256), ptosis of the colon and cecum (p. 259) play a part hitherto unsuspected as the causation of constipation. Recently much light has been thrown on many difficult and obstinate cases by the use of the Roentgen ray. Mechanics play an immediate rôle in constipation, as will be appreciated by referring to Fig. 48. The long sigmoid loop is an important factor in causing constipation, and even after infancy anal sphincter spasm may be an important etiologic factor.

*Regular Habits.*—As a rule, children who are presented for treatment after the second year have not had the benefit of carefully regulated habits of life, so that our first step is to correct bad habits that may have a bearing on the condition, and to teach good habits. The desirability of establishing in the child the habit of a bowel evacuation at a certain definite time every day should be impressed upon the mother or nurse. In order to bring this about an attempt should be made to induce a movement of the bowels by voluntary effort every morning after breakfast. Not a few children are too busy, too active in their play, to respond to the call of nature when it comes, and if it can be repressed, they say nothing about it. If a certain time of the day is selected for the evacuation, and if the child is required to remain at stool until it occurs naturally, or by means of a suppository after fifteen minutes have elapsed, much is accomplished by this means alone toward establishing the normal habit.

*Diet.*—Ultimately, much may be accomplished in these cases by diet. Foods other than milk may after infancy be given, so that a high-protein milk, rich in casein, is not necessary. As it is desirable to continue the

use of milk at this age, the following combination of top milk and water may be used instead of plain milk: A quart bottle of milk may be allowed to stand at a temperature between 40° and 50° F. for five hours, after which the top 10 ounces are to be removed with a Chapin dipper. (See Fig. 6, p. 70.) The 10 ounces of top milk may then be mixed with 20 ounces of oatmeal gruel or plain boiled water and given as a drink.

The giving of high-fat mixtures in constipation is sometimes overdone even in feeding older children. We seldom find a child five years of age who can digest day after day a milk or cream mixture containing over 4 per cent. of fat. Attacks of acute indigestion and faulty nutrition are very apt to result when too high a fat is persistently given. In not a few instances grave malnutrition results from an attempt to relieve the constipation by high-fat feeding. It must also be remembered that high-fat mixtures, if given to children of any age, may produce constipation, with hard, very light colored, and foul-smelling stools. By using the top milk, diluted, we give a sufficient amount of fat and relieve the constipation by removing a considerable percentage of the casein, the usual constipating element, the percentage of which in the 30 ounces of food, above referred to, is but one-third that in whole milk. Of course, the nutritive value of the dilution is less than that of full milk, but the child is now at an age when protein can be given in other forms than in the milk.

*Diet After the Second Year.*—White wheaten bread, wheaten flour crackers, with full raw milk should form no part of the dietary of these patients. It is best to give to parents of children we are treating for constipation a list of permissible articles of food from which suitable meals may be prepared. The following articles of diet may be allowed:

Animal broths, purées of peas,  
beans, and lentils.  
Rare roast beef.  
Rare steak.

Hashed chicken.  
Lamb chops.  
Soft-boiled eggs.

Green vegetables, such as:

Peas.  
String beans.  
Spinach.

Asparagus.  
Strained stewed tomatoes.  
Cauliflower, mashed.

Cereals, as follows (each cooked for three hours):

Cracked wheat.  
Oatmeal.

Hominy.  
Cornmeal.

The cereals may be served with a small amount of milk and sugar or, better, with butter and sugar.

Bran biscuits.  
Oatmeal crackers.  
Graham wafers.

Zwieback.  
Whole wheaten bread.

Desserts:

Stewed rhubarb.  
Stewed or baked apple.  
Stewed prunes.  
Custard.

Cornstarch.  
Plain vanilla ice-cream.  
Junket.

Malted milk may be given as a drink, 6 teaspoonfuls of malted milk in 8 ounces of hot water being given once or twice daily. An agreeable change in the taste of the malted milk may be made by the addition of a teaspoonful of cocoa. If milk is given as a drink, the top 10 ounces from a quart bottle should be used as described above, mixed with 20 ounces of boiled water or oatmeal water.

A child in fair health after the second year usually thrives best on three meals daily. If he is delicate, or if a fourth meal does not interfere with the appetite for the other meals, it may be allowed. The extra meal, however, should be light, and is best given between 2 and 3 o'clock in the afternoon. For a child suffering from constipation this meal may consist of a cup of broth with a Graham or oatmeal cracker. Orange juice or a scraped raw apple may also be given at this time. When only three meals are allowed, the orange juice or scraped apple should be given in the afternoon about two hours before the evening meal. Six ounces of prune juice will be found very useful. The giving of the fruit juice or the apple on an empty stomach is a valuable aid in relieving chronic constipation. These patients should also be encouraged to eat plenty of butter. The use of olive oil internally is of as much service here as in treating bottle or nursing babies. From 2 to 3 teaspoonfuls are to be given after each meal. Oil is usually well borne by the stomach; in fact, many children become very fond of it. Inasmuch as it is more of a food than a medicine, its use may be continued for months if necessary.

*Diet After the Fifth Year.*—Permissible articles for a constipated child of from five to ten years of age include those mentioned above, with the addition of dates, figs, raw and cooked fruits, baked and stewed potatoes, meats, baked and broiled poultry, and fish. The latter should be served plain, without sauce. Plain puddings may also be allowed. One or two raw apples, an orange, or a large peach or pear should be given every afternoon. It is not promised that in a case of chronic constipation the above diet will at once produce normal bowel movement. The diet must be continued for weeks in some cases before marked benefit will be observed; in others the results are very prompt and satisfactory.

*Local Measures.*—Enemata and suppositories will be necessary at first until the habit of an evacuation of the bowels at a certain time every day is established. Such measures, however, should be continued but a very short time.

*Drugs* may be of temporary service. The cascara preparations are the best for this condition. If the child can swallow a pill or a tablet, the drug may be given in this form. The 1-grain tablets of cascara may be ordered, and the nurse instructed to give from one to three or four at bedtime. If the drug has been properly prepared from the well-seasoned bark, a reasonable dose will occasion no griping, and the amount given on succeeding nights may be diminished instead of increased, as is often necessary with many other laxatives. A most satisfactory form of medication has been the following combination:

R.	Sodii bicarbonatis.....	ʒij
	Syr. rhei aromatici,	
	Fluidext. cascarae sagradae aromaticæ.....	āā ʒij
M. Sig.	— $\frac{1}{2}$ to 1 teaspoonful after each meal.	

After the diet and habits of life have been arranged the mother or nurse should be instructed to give the prescription three times daily after meals in sufficient amount to produce at least one free evacuation daily. The mixture is very pleasant to the taste and is well taken. As its administration is continued, less will be required, but it is to be insisted upon that the laxative be given three times daily, even though the dosage be reduced to 3 drops at a time. There is always a temptation on the part of those in charge of the patient to give one large dose at bedtime. The results are not as satisfactory when this is done. In a very large number of cases we have been able, with intelligent home co-operation, to discontinue the medication entirely after a month or two.

Another laxative of value is a combination of 1 to 1½ grains of phenolphthalein in a tablet with chocolate. One to three such tablets may be given daily.

Castor oil, calomel, or podophyllin should never be given without other indications than simple constipation. In the cases in which the stools are soft, but difficult of passage because of deficient peristalsis, the tinctures of *nux vomica* and *belladonna* may be given with benefit if continued for a considerable time. A child three years of age may be given 3 drops of the tincture of *nux vomica* and 2 drops of the tincture of *belladonna* three times daily in tablet, capsule, or liquid form. The constipation which accompanies mucous colitis is referred to under that heading. Liquid petrolatum may also be used for these patients. A large dose may be required at first—perhaps 1 or 2 ounces at bedtime.

**Treatment of Obstinate Constipation.**—Children who resist the above method of treatment after several months' trial may be classed with those who have some considerable intestinal anomaly—usually an elongated and often a displaced sigmoid (p. 256). For these, daily abdominal massage by a skilled person, together with the diet suggested, and the internal use of liquid petrolatum will prove effective.

### INTESTINAL OBSTRUCTION

Conditions impeding or preventing normal evacuation of the bowels may be either congenital—due to a malformation of some portion of the intestinal tract—or they may be acquired.

Congenital malformation may be found in any portion of the tract, but exists most frequently at or near the outlet, or in the region of the duodenum. According to Silverman 42 per cent. of the cases of congenital malformation involve the duodenum. Obstruction at the outlet of the bowel may be due to an imperforate anus, or the absence of, or atresia of, the lower portion of the rectum. The treatment of this deformity is surgical.

The most common cause of acquired obstruction is intussusception (p. 277). Peritonitis, both acute and chronic, may cause a cessation of bowel action. Tuberculous peritonitis, through the formation of fibrinous bands and adhesions, may cause sufficient constriction of the gut to prevent the passage of the intestinal contents. In such cases, also, relief is best furnished by surgical measures.

Acute infective peritonitis (p. 291), producing a complete cessation

of peristalsis, due to paralytic ileus, acts indirectly as a means of preventing the normal passage of the bowel contents. The infection is usually secondary. Operative procedures may be attempted, but all our cases have been fatal. Two underwent operation, as it was feared there might be an intussusception or a volvulus. In one case peritonitis followed pneumonia, the infection being due to the pneumococcus.

Strangulated hernia is a condition by no means difficult of diagnosis and demands prompt surgical relief.

Intra-abdominal tumors, such as sarcoma of the kidney and hydro-nephrosis, may cause obstruction through pressure on the intestine.

*Illustrative Cases.*—Fecal impaction was found in 2 cases of intestinal obstruction seen in consultation. There had been prolonged constipation with insufficient evacuations, owing to neglect on the part of the attendants. The duration of this condition it is impossible to state, as the children were permitted to go to the toilet alone, and as both were under five years of age, but little dependence could be placed upon their testimony. In both cases enemata and cathartics had been tried in vain. There was vomiting and slight abdominal distention. There was no fever and no marked tenderness on pressure. In the writer's opinion the vomiting was due chiefly to the medication, for it ceased when drugs were discontinued. Both children responded to massage and injections of molasses and water. Eight ounces of molasses and 8 ounces of water were introduced by means of a rectal tube at intervals of four hours. One case was relieved after the second injection, the other after the fourth. Massage was early brought into use. This was given for thirty minutes and repeated after an interval of ninety minutes. The interrupted massage was continued until an evacuation occurred.

An unusual case of intestinal obstruction was seen in a wretched, premature infant, five months of age, weighing about 7 pounds. The child had a congenital heart lesion and deformities of the ears. He was suddenly taken ill with vomiting, and the passage from the bowel of pale mucus streaked with blood. No tumor could be felt, but a diagnosis of intussusception was made and the abdomen opened. At the site of the obstruction was a Meckel's diverticulum which had twisted the gut so as to prevent the passage of gas or intestinal contents.

#### PARALYTIC ILEUS

Two infants under one year of age, ill with severe intestinal toxemia, developed intestinal obstruction with marked abdominal distention. Exploratory abdominal incision in one and autopsy on the other failed to show any structural abnormality.

#### INTUSSUSCEPTION

Intussusception of the bowel consists of a prolapse—an invagination—of a portion of the intestine into an immediately adjoining portion.

**Types.**—While certain portions of the intestine are particularly liable to be involved, the invagination may take place in any portion of the gut. Thus the small intestine may be the part involved—the enteric form. The colon alone may be involved—the colic type. By far the most common form is the prolapse of the cecum, and more or less of the ileum into the colon, the valve forming the apex of the tumor. This is known as the ileocecal type.

*Invagination Found at Autopsy.*—At autopsy it is of most common occurrence to find invagination of the small intestine. The writer has repeatedly seen 6 to 8 invaginations in one subject. They occur at death, and are of no significance. It is unusual to find more than 4 or 5 inches of the gut involved.

**Etiology.**—The cause of the intussusception in the great majority of cases is unknown. Various theories have been advanced from time to time, none of which deserves mentioning. Occasionally local causes will

explain the condition. In one case Meckel's diverticulum caused the intussusception. In another there was a persistent incomplete reducible invagination of the transverse and descending colon into the sigmoid. It was impossible to keep the parts in the normal position, and laparotomy was resorted to in order to learn the cause of the prolapse. The entire colon was found displaced, the hepatic flexure being bound to the abdominal wall by a firm adhesion  $\frac{1}{2}$  inch above the umbilicus. This caused a displacement downward of the transverse and descending colon, which underwent invagination. A case at the Babies' Hospital showed that the invagination had taken place at the site of a large and thickened Peyer's patch in the lower ileum. Here, evidently, the gut was more resistant, and the portion above, during active peristalsis, slipped into the less motile section.

It is peculiar that nearly all the cases occur in well-nourished, vigorous, breast-fed babies.

**Age.**—The age incidence is striking. The majority of the cases occur between the third and ninth months of life. Our youngest patient was ten days old. Holt's statistics of 358 collected cases are as follows:

28 cases under 4 months				18 cases from 10 to 12 months			
113	"	"	4 to 6 months	32	"	"	1 to 2 years
71	"	"	7 to 9 "	96	"	"	2 to 10 "

**Symptoms.**—The onset is usually sudden, with evidence of pain and vomiting. A further early and very important sign is the marked prostration, which is much more pronounced than in an ordinary gastro-enteric disease. The child in a few hours may look very ill. There is cyanosis, and the pulse is rapid and small. This symptom-complex was noted in several cases. The vomiting, which is very active, is repeated at fairly short intervals, and after the stomach is emptied bile-stained mucus is ejected with much straining. Medication, food, and water are ejected as soon as they reach the stomach. There is evident tenesmus; the child strains, and at first passes normal bowel contents, followed by bile-stained mucus, and later clear mucus streaked with blood—a most reliable diagnostic sign. Blood is not always present. In some instances only white, tenacious mucus is passed or removed on the examining finger. On the other hand, the blood may be present in large amount, constituting a very definite hemorrhage. The prostration, urgent at the beginning, increases, and the patient may die of shock before operation is attempted.

*The Presence of Tumor.*—If the case is seen early, a sausage-shaped tumor may be felt, or the rounded apex of the tumor may be felt by rectal examination if the descending colon is involved. If the patient is not seen until several hours or days have elapsed, the accumulation of gas in the intestines renders the palpation of a tumor impossible.

Occasionally a case is seen in which the onset is more gradual, in which gas and bile-stained mucus will be passed for a day or two. This indicates that the invagination is not sufficient to close the lumen of the gut. Finally, only blood and mucus are passed and the obstruction is complete. Three or four days may be required to bring this about. Vomiting is a less pronounced symptom in these cases of gradual development.

Stercoraceous vomiting does not occur in young infants.

*The Temperature.*—The temperature range is of no significance. In many cases the temperature is never above 100° F.

**Diagnosis.**—There is no satisfactory excuse for so many failures in diagnosing intussusception in infants. The reason for the failure to appreciate the condition is because physicians too readily interpret active vomiting, with green, mucous, and bloody stools, as significant of gastro-enteric intoxication.

Distinguishing features of intussusception are: Vomiting, sudden and urgent by a previously well infant, who may be breast fed; shock and collapse out of proportion in severity to the other symptoms; the passage of clear, mucous stools streaked with blood, together with the presence of pain of a paroxysmal nature, the absence of the passage of flatus, and the sudden distention of the abdomen.

The presence of a tumor which can be felt either by abdominal palpation or in the rectum occurs in perhaps 80 per cent. of the cases. In cases of ileocecal intussusception the tumor may be difficult to map out, particularly if there is much distention of the abdomen. Under these circumstances anesthesia should be used in suspicious cases. Rectal examination is always a valuable aid and should never be neglected.

*Illustrative Case.*—A breast-fed infant three weeks old suddenly terminated a diarrhea of two days' duration and in the next thirty-six hours vomited bile-stained fluid, developed extreme abdominal distention and rigidity, and failed to respond to enemata. The diagnosis of intussusception was made by several observers. Operation, however, disclosed a fatal spreading peritonitis with much exudate containing *Streptococcus hemolyticus*, but revealed no obstruction or initial focus of inflammation in the bowel. Extreme enteroparesis had simulated obstruction of the intestine and the absence of a visibly infected umbilicus left the source of the infection (which may have been pulmonary) in doubt. In this instance it is noteworthy that a localized abdominal tumor was not felt. Vomiting was not persistent and bloody mucus appeared only after rectal examination and was perhaps due to slight trauma of the mucosa.

The **prognosis** in the immediate, complete type of obstruction depends largely upon the time of making the diagnosis and the promptness of operative procedures. The chance for recovery from operation decreases rapidly with each succeeding day.

It is impossible to give statistics of value. It is safe to say that over 50 per cent. of these cases are curable by some means if they are diagnosed early. The high mortality—50 to 80 per cent.—is due to two conditions: the tender age of the patients and the fact that the cases seen in consultation and those seen in children's hospitals usually have been treated for something other than intussusception. Sometimes such treatment has been continued for several days. By the time those cases reach the hands of the surgeon there may be extensive adhesions, gangrene of the involved portion of the intestine, and an exhausted child to deal with.

**Treatment.**—*Reduction by Water-pressure.*—This means is only of use when the intussusception has involved only the large intestine. In the ileocecal type operation at the earliest moment is the only resource. A well-oiled catheter, No. 18 American, or a small rectal tube, is attached to the small hard-rubber tip of a fountain-syringe. Two quarts of a normal salt solution are placed in the bag, which is hung at an elevation of 4 feet above the child's body. The colon, or that part of it below the

intussusception, is slowly filled with the warm salt solution. A small wet towel is tightly wrapped around the catheter, and fairly strong pressure is made at the anus by an assistant, in order to prevent the escape of the fluid. With the child on his back, with both hands free, the buttocks are elevated on a pillow or bed-pan at a plane 10 inches above the shoulders. In the cases in which the tumor is palpable, an attempt is made, by gentle abdominal manipulation, to reduce the intussusception. This in 2 cases the writer has succeeded in doing. Prolonged and repeated attempts at reduction should not be practised.



Fig. 56.—Ileocecal intussusception (Kerley and LeWald).

*Illustrative Cases.*—*Case 1.*—A child, two and one-half years of age, was brought at midnight with a history of a severe attack of colic about 9 o'clock, which was followed by severe attacks of vomiting and two stools of mucus and blood. Gentle manipulation of the abdomen showed a large, sausage-shaped tumor, about 5 inches long, in the left hypochondrium, which indicated an intussusception. The tumor could not be felt by rectal examination. Water-pressure, as described above, with abdominal manipulation, reduced the intussusception in a few minutes.

*Case 2.*—The other patient was a baby nine months of age. The senior author saw the child in consultation after the intussusception had existed for six days. The child was comatose and in profound collapse. He was pulseless, but the heart sounds could be faintly distinguished by the aid of stethoscope. The rectal temperature was 96° F. The abdomen was greatly distended. The child had been treated for cholera infantum, although for five days nothing but white mucus tinged with blood had been passed. Palpation revealed a sausage-shaped tumor extending along the entire left side of the abdomen, which, in spite of the abdominal distention, could easily be made

out by firm pressure. As the child was unconscious, there was no resistance to the examination. By rectal examination the projection of the involuted gut, which resembled the cervix uteri, could readily be distinguished. The condition of the child precluded all chance of surgical relief, and the writer hesitated to use water-pressure, fearing that the gut might be gangrenous and a rupture result, or that there might be adhesions sufficient to prevent reduction, and that the child might die during the manipulations. This situation was explained to the parents, who, after considerable urging, consented to a trial being made. The patient was accordingly given 1/100 grain of strychnin, 1 drop of tincture of strophanthus, and 30 drops of brandy hypodermically. The water-pressure was applied in the usual way, and it was with the greatest surprise and with supreme satisfaction that the writer felt the tumor slowly give way, to be followed by an expulsion of gas and a quantity of very fetid fecal matter. A hot colon flushing at 110° F. with a normal salt solution was given a few minutes later. This was all retained, and six hours later 12 ounces more were given. Hot-water bottles and bags were placed about the child. He had sufficiently revived in an hour after the first colon flushing to be able to swallow diluted brandy and egg-water, both of which were freely given. A rapid recovery followed.

This case, to the writer, was interesting in many ways, particularly as it emphasized what we sometimes see in work among children when victory is snatched from the jaws of evident defeat—that we should never cease our efforts so long as life lasts.

*Case 3.*—The following notes in conjunction with Fig. 56 give briefly the record of a case terminated favorably by operation:

"Male, aged sixteen months. On day of illness awoke apparently normal, but later refused regular feeding. Castor oil and an enema administered; results unsatisfactory. Vomited during the following night. No rise in temperature; no palpable mass; no point of tenderness. Clinical diagnosis: Suspected intussusception.

"*Roentgen Examination.*—An opaque enema disclosed site of obstruction and its cause: intussusception of the terminal ileum into the cecum. The injected column of opaque material, when it met the intussuscepted portion of the ileum, spread out over it in a thin layer, leaving the central filling defect in the cecum which could hardly be simulated by any other known condition (Fig. 56).

"*Operation.*—Abdomen palpated under anesthesia; no mass felt. Due to the Roentgen diagnosis a small incision was made directly over the cecum. Intussusception reduced in a very short time. Recovery.

"*Comment.*—Only a very few cases of Roentgen diagnosis of intussusception have been reported. As the Roentgen findings are so conclusive in a case of this sort, they should not be omitted with a questionable diagnosis."

### INTESTINAL CYSTS OR DIVERTICULA (CONGENITAL)

A most unusual case of intestinal obstruction was presented by a well-nourished, breast-fed child, five weeks of age, who became ill with what appeared to be intestinal indigestion. There was a slight elevation of the temperature, and the stools were green, undigested, and watery. The family physician, Dr. Walter Fleming treated the case by the usual methods. An improvement in the stool followed, but a marked degree of tympanites remained. Feces and gas were, however, passed in small amounts, and at times the abdomen was sufficiently soft to allow of free palpation. The tympanites gradually increased, and instead of being intermittent, persisted. About one week after the writer first saw the case it came under his immediate supervision in New York City.

Feces and gas were passed with difficulty—occasionally there was a fairly large stool. The child was in no way apparently ill, and suffered only from the abdominal distention; when this was relieved, the baby took food well and was content. In spite of our every effort directed to relief through diet, medication, local measures to the abdomen, and colonic treatment, the tympanites gradually increased and became permanent and extreme.

The patient was sent, at about the sixth day of the writer's observation, to the Babies' Hospital, where all attempts at reduction of the gaseous distention were likewise futile.

An exploratory incision was then made into the abdominal wall by Dr. William A. Downes, who discovered a tumor of the cecum. An artificial anus was made in the ileum above the valve, and the tympanites was relieved; but the child died shortly from exhaustion.

Postmortem examination showed just above the ileocecal valve, and within 5 cm. of it, a round, sessile cyst, 3 cm. long and 2.5 wide by 0.75 cm. high, the mucosa over it thin, stretched, congested at either side, pale on top, with dilated vessels from the base radiating over the sides and top. Immediately beyond was a second cyst, 2.5 x 2.5 cm. and only 0.25 high; close to it, almost bilocular, was a third, 2.5 x 2 and 0.75 cm. high. Contents showed mucolymph within a smooth lining. Between the mucosa

and submucosa the muscle was normal. Next to the last cyst was a part of a Peyer's patch, mucosa congested, walls thickened and edematous. The colon was congested.

The cysts or diverticula had encroached upon the lumen of the gut, and because of their proximity, formed a sufficient obstruction to preclude the passage of gas and the intestinal contents. Evidently the later growth of the cysts was quite rapid, as the obstruction caused symptoms increasing only gradually in severity, and permitted of the passage of feces until a day or two before the operation.

Blackader, of Montreal, reported a case of congenital intestinal cysts, similar to the foregoing, before the American Pediatric Society in 1913. He was able to find records of but 3 other cases of congenital intestinal cysts in the literature. The condition, according to Gant, is not uncommon in adults; and in them the cysts are usually found in the sigmoid and colon and are looked upon as acquired.

#### MECKEL'S DIVERTICULUM

Meckel's diverticulum, the remains of the omphalomesenteric duct, is present in 1 or 2 per cent. of all individuals and is slightly more common in the male sex. It is usually situated about a foot above the ileocecal valve and may occur as a fibrous cord or retain a patent lumen. The tip may be attached to the umbilicus or may be free. In the latter case there are usually no symptoms associated with its presence.

The *pathologic conditions* which may be associated with Meckel's diverticulum are:

1. Obstruction or strangulation of intestine giving the usual symptom of obstruction.

2. A patent lumen which may extrude feces, mucus, worms, or even intestine, the bowel in some cases protruding and strangulating at the umbilicus.

3. A cystic tumor containing meconium formed in the duct, obliterating it at both ends.

4. Calculi or foreign bodies resting in the lumen.

5. Malformations or excessive involution causing contraction or kinking of the gut by traction.

6. A free diverticulum which may invaginate with a subsequent ileocecal intussusception.

7. Volvulus.

8. Hernia.

9. Diverticulitis, of which the pathology and the signs and symptoms are analogous to those of appendicitis.

The *differential diagnosis* from appendicitis is practically impossible. Whereas in appendicitis inflammation *per se* is more common than obstruction, obstruction is more commonly associated with Meckel's diverticulum than a primary diverticulitis. The point of tenderness is usually a little higher and closer to the umbilicus than McBurney's point. There may be puffiness and resistance of the abdominal wall in the same region. There is usually in the early stages very little tympanites and there may be blood in the stools or vomitus. The knowledge of the earlier existence of an umbilical fistula or other congenital malformation may help in diagnosis. Otherwise the symptoms are closely identical with those of intestinal obstruction or appendicitis.

The *treatment* is surgical.

*Illustrative Case.*—In a patient nine months of age there was an evident incomplete intestinal obstruction intermittent in character evidenced by marked constipation and periodic distention which was very pronounced. The peculiarity of this distention was that it could be relieved entirely by an enema combined with abdominal manipulation. The effects of such procedures could only be explained by some obstruction of a mechanical nature that was removed by this method of treatment. Abdominal section showed a thick fibrous cord, the remnants of the omphalomesenteric vessels extending from the umbilicus to the hepatic flexure of the colon and not to the ileum as would be expected. There evidently had been an infection of these vessels immediately after birth which had not been recognized.

### HERNIA AT THE UMBILICUS

Protrusion of the abdominal wall at the umbilicus may be due to an improper development of the blastodermic layers, with non-union (exomphalos, hernia into the umbilical cord); or may result from a true fetal hernia after the umbilicus is lined with peritoneum, or a hernia occurring after birth through a weak umbilical scar.

### HERNIA OF THE UMBILICAL CORD

**Morbid Anatomy.**—This condition is a true fetal defect, due to a failure of union of the blastodermic layers, leaving as the anterior wall of the abdominal cavity a membrane covered with amnion externally and with peritoneum internally. Through this weakened parietal wall may occur a protrusion usually the size of a pear or an apple, but which may range from the size of a small finger-tip to that of a child's head. The tumor is glistening and transparent, and shows through its walls the contents of the sac. These may include any or all of the abdominal contents, stomach, liver, Meckel's diverticulum, omentum, intestines. Occasionally the child will be born eviscerated from the bursting of such a hernia in labor; and often its occurrence is associated with that of a spina bifida.

The covering of this variety of hernia falls off with the drying up and dropping off of the umbilical cord. The contents are thus exposed. If the defect is small enough, it may granulate and epithelialize; but if this does not happen and operation is not resorted to, peritonitis and death will probably ensue.

**Treatment.**—Operation offers a means of cure in these cases. Kindt reported 50 cures in a series of 65 operations.

The management, therefore, should not be expectant. In view of the good results of operation, an attempt should be made as soon as possible after birth to close the opening in the abdominal wall either by cutting away the sac in its entirety and suturing the abdominal walls together, or by separating the amnion from the peritoneum, replacing this and its contents into the abdominal cavity, and then suturing the walls.

### CONGENITAL UMBILICAL HERNIA

**Etiology.**—This type of hernia occurs after the closure of the visceral layers, and is due to pressure within the abdominal cavity and to the comparative weakness of the upper part of the umbilical ring, and to the extension of peritoneum surrounding the umbilical vessels, which, forming a sac, directs the force of the increased intra-abdom-

inal pressure. It may occur through the linea alba, just above the umbilical ring, either alone or in conjunction with hernia at the umbilicus.

**Prognosis.**—The tumor is usually from  $\frac{1}{4}$  to 1 inch in diameter, and may protrude as much as  $1\frac{1}{2}$  inches. There is seldom any discomfort, although when the contents are extruded and reduced there may be some pain. Danger of strangulation is slight, and the prognosis as regards cure is good. The time required ranges from six months to two years. The younger the child, the quicker the cure.

**Treatment** consists in retaining the hernia and allowing the opening to close, and is, therefore, entirely mechanical. Operation is rarely necessary. Of 2000 operations for hernia in children under fourteen years of age at the Hospital for Ruptured and Crippled, but 1.3 per cent. were for umbilical hernia. By far the most effective method of treatment is to bring together over the umbilicus (Fig. 57) two folds of skin, so that they meet in the median line and invert the umbilicus. These folds of skin thus form a splint which is retained by a strip of moleskin adhesive plaster 1 or 2 inches wide and sufficiently long to hold fast to the skin—usually



Fig. 57.—Umbilical hernia reduced and adhesive plaster applied.

about 4 to 6 inches. This method in our hands has proved the most satisfactory and has been followed by the most rapid cures.

The objection to the use of a covered button or any form of pad, many of which have been recommended, is that unless it is very large the pad is apt to make strong pressure upon the abdominal opening, and while keeping the hernia reduced, prevent rapid closure of the ring itself. A pad or button may also interfere with the circulation and thus hinder the nutrition of the muscles and cause the weakness to persist. Umbilical trusses and bandages have been used repeatedly, and all have proved hopeless failures, and for one reason chiefly—the difficulty of keeping them in position. Any intelligent mother or nurse can be taught to apply the plaster as suggested above. The child may be bathed with the plaster in position. Ordinarily, it is best to apply a fresh piece every fifth day. Irritation of the subjacent skin sometimes occurs, and if this tendency exists, folds can be made at right angles to those previously made and the plaster applied again at right angles to the folds. By this means the excoriated skin remains uncovered.

### VENTRAL HERNIA AND DIAPHRAGMATIC HERNIA

This form of hernia is of congenital origin, and is only occasionally seen in infants. It may be associated with umbilical hernia or may occur independently. It may be due to a failure of the recti to unite in the median line, or to weakness or imperfect development of the fibers of either muscle. Muscular atrophy following poliomyelitis was the cause noted in two cases.

There is rarely any great protrusion of the abdominal contents, as in the other forms of hernia. Usually a ventral hernia manifests itself in a fulness or distinctly localized elevation of the skin over the site of the absent or weakened muscle tissue in the abdominal walls. The usual location is in the hypochondrium. Two or three hernias were observed in one subject in this locality. In one case the hernia was in the right lumbar region. Not all cases require treatment.

**Treatment.**—The application of a 4-inch strip of zinc oxid adhesive plaster 2 or 3 inches wide, placed flat on the skin over the hernia is all that will usually be required. The support thus furnished must be continued for several months. Operation may sometimes be necessary, but in our experience has not been required.

**Diaphragmatic Hernia.**—These cases are very unusual. Only two have come under our observation. In both cases, as in others reported, the defect was located at the left anterior border of the diaphragm. This allowed the intestines to pass into the pulmonary cavity, displacing the heart and the lungs. As may be imagined, the physical signs thus produced are most unusual and puzzling. (See p. 383.)

### INGUINAL HERNIA

Inguinal hernia is of rare occurrence in female infants, but is comparatively frequent in males. It may be present at birth, or develop at a later period. The right side is more frequently involved. Double hernia, however, is not at all infrequent.

**Etiology.**—*Anatomic Conditions.*—The special anatomic condition predisposing to inguinal hernia in infancy is the short and direct course of the inguinal canal. In the infant the internal abdominal ring is almost directly behind the external ring, and on practically the same level. Incomplete closure of the inner opening, combined with weakness of the peritoneum in the neighborhood of the ring, thus affords easy egress to the hernia. At the femoral canal, on the contrary, the possible hernial opening is quite adequately protected, owing to the close relationship existing in the child between the anterior superior iliac spine, Poupart's ligament, and the spine of the pubis. Consequently femoral hernia in childhood is rare.

A more direct and exciting cause of hernia is the pressure exerted by the abdominal muscles in crying, particularly from colic, and during paroxysms of whooping-cough.

**Diagnosis and Differential Diagnosis.**—Inguinal hernia in infants is usually readily reducible, and this fact permits of making the diagnosis positive.

Strangulated inguinal hernia may be confused with hydrocele of the cord, enlarged inguinal glands, and undescended testicle.

In *hydrocele* the tumor is translucent, which may be readily proved by means of the following light test: A piece of dark, stiff paper is rolled in tube form, so that the orifice is  $\frac{1}{2}$  inch in diameter. One end of the paper tube is placed over the tumor, which is supported while a flash-light is placed underneath. The observer's eye is now applied to the other end of the tube. If the light is not transmitted through the mass, hernia in all probability is present.

Further, if strangulated hernia has persisted for even a few hours, there will be vomiting and pronounced abdominal distention.

In the condition known as *undescended testicle* the testicle is absent from the scrotum and may be demonstrated in the canal as a small, ovoid, movable mass. The wearing of a truss over an undescended testicle has been witnessed.

When due to *enlarged inguinal glands*, the tumor is placed to the left or right of the canal. It is firm, hard, and fixed, and usually more than one gland is involved. It would seem that there should be no necessity for confusion in the differentiation of a gland mass.

**Prognosis.**—The prognosis for cure of uncomplicated hernia without operative procedure is good. Many cases are cured in from six months to one year through the use of suitable appliances.

**Treatment.**—The treatment of inguinal hernia in infants and young children is by mechanical appliances or by operation. In infants under one year of age operation is rarely required. A most satisfactory means for treating inguinal hernia has been the Hood frame truss, made of hard rubber. Measurement for the truss is taken around the hips on a plane with the hernia. The truss, if placed in hot water for a few seconds, or warmed slightly before a fire, can readily be bent, so as to fit the patient comfortably. When the truss is removed for the purpose of cleansing, which should be done twice a day, a helper should be at hand to maintain support at the ring, so that there shall be no descent of the hernia. One descent may mean that several weeks' care has been brought to naught. The child should wear the truss day and night. The skin, where subject to pressure, should be kept well powdered when the truss is first applied, and the child is often made more comfortable by placing absorbent cotton beneath the hard-rubber pad.

As the child grows the truss will have to be changed frequently. Its use should be continued for at least six months after the last descent of the hernia. Operation is required when the hernia becomes strangulated, and this procedure is always to be advised for older children if a cure is not effected after two years' treatment by a truss. Many cases entirely recover in less than six months. The use of the truss in such instances, however, is to be continued with a view to protecting the parts and preventing a recurrence of the hernia under stress.

#### DUODENAL ULCER

Duodenal ulcer is a very unusual disease in infants. In all, only a few score cases have been reported. Holt found 99 cases reported in the

literature. To this he added 4 cases of his own which were observed at the Babies' Hospital. Among 1800 autopsies, largely in children under one year, the postmortem records showed but 4 cases of duodenal ulcer. More recently Veeder<sup>1</sup> reported 5 cases. Gerdine and Helmholtz<sup>2</sup> reported 11 cases including necropsy findings, from which series of cases they deduced that the condition was of an epidemic infectious form in which diplococci and streptococci played an etiologic rôle.

**Age.**—The great majority of the cases reported have occurred in infants under six months of age. The lesion has been found postmortem, in most of the cases not being recognized during life. In Veeder's cases proved by autopsy the diagnosis of duodenal ulcer was made antemortem in one only.

Two cases of duodenal ulcer in children have recently come under the writer's observation.

*Illustrative Cases.*—*Case 1.*—A boy three years old passed free blood in his stools in large amount and vomited blood repeatedly. Abdominal incision disclosed extensive peritonitis, with a mass of adhesions about the pylorus, nature's attempt at closing the perforations. The patient died a few hours after operation.

*Case 2.*—A boy two years of age became ill with abdominal pain and vomiting, followed by marked abdominal distention. On the fifth day he was seen in consultation and a diagnosis of a perforated appendix was made and concurred in by the operating surgeon who, however, found the appendix normal and a perforating duodenal ulcer. The abdomen contained about 1 pint of bile and blood-stained fluid. The child made a rapid recovery.

**Pathology.**—The lesions as described by Veeder are as follows: The ulcers may be single or multiple, and vary from small areas of superficial necrosis to cleanly punched-out ulcers which involve all the layers of the intestinal wall, and which in a few cases have perforated, with a resulting peritonitis. They are found between the pylorus and the ampulla and are most commonly situated just beyond the pyloric ring. The ulcers are usually located on the posterior wall.

**Symptoms.**—The only symptom of value is the presence of blood mixed with the stools. When this occurs in a marantic infant, ulcer should always be suspected. We would then have to differentiate duodenal ulcer from peptic ulcer, polypus of the lower intestine, fissure of the rectum, intussusception, ulcerative colitis, melena neonatorum, and diverticula. It will be observed that the diagnosis of duodenal ulcer is not a simple matter, and it is altogether probable that in the future diagnosis of the disease will continue to be made postmortem, particularly as in some of the cases no hemorrhage occurred at any time.

## APPENDICITIS

**The Appendix.**<sup>3</sup>—This organ, normally, is located in the right iliac fossa, subjacent to McBurney's point, which marks the junction of the two lower thirds of a line connecting the right anterior superior iliac spine with the umbilicus. This position is attained as the result of intra-uterine changes in the intestinal canal, involving a gradual migration of the ileo-

<sup>1</sup> Amer. Jour. Dis. Child., vol. vi, pp. 382-393.

<sup>2</sup> Ibid., vol. x, No. 6, December, 1915.

<sup>3</sup> Vide: Anatomy and Physiology of the Appendix, by Dr. Andrew McCosh, in American Practice of Surgery, Bryant and Buck vol. vii, p. 618 et seq.

colic junction from a primary position in the left iliac fossa upward to the right, beneath the liver, and finally downward into the right iliac fossa. When these changes are not completed, the organ will not be found in its normal adult location, but frequently higher up. Because of variations in development the appendix may or may not have its origin from the extreme lower portion of the cecum. The lumen of the appendix at its base is often very minute. Both of these facts partially explain the liability to inflammation. The total diameter of the organ is about  $\frac{1}{4}$  inch, and the length, which is extremely variable, is usually between 2 and 3 inches. Various abnormalities in shape and direction occur, chiefly as a result of peritoneal adhesions.

The appendix contains serous, muscular, submucous, and mucous layers. It is, however, essentially a lymphoid structure, well deserving the name "abdominal tonsil." Like the tonsil, it attains its maximum development early in life, and, with the occurrence of the atrophic changes common in later years, shows a diminished susceptibility to infection.

**Appendicitis** is not so rare a disease of early childhood as is usually taught. It occurs with sufficient frequency for the practitioner not to forget the possibilities of its unexpected development.

Both acute and chronic cases are often overlooked because of the difficulty in diagnosis. In describing appendicitis, writers are inclined to divide the disease into types such as catarrhal, suppurative, gangrenous, and perforative. Such division for our purposes is hardly practicable. Because of the excess of lymphoid tissue in the child's appendix, the pathogenic process may be extremely active, and a case that is catarrhal today may be gangrenous tomorrow. Not all catarrhal cases go on to the later stages. Nevertheless, it must always be remembered that appendicitis in the child is usually a much more active disease than in the adult.

**Bacteriology.**—In order of frequency of attack according to Bower,<sup>1</sup> the micro-organisms directly causing appendicitis are *Bacillus coli*, *staphylococcus*, *streptococcus*, *B. pyocyaneus*, and the *tubercle bacillus*.

**Age.**—No age appears to be exempt. Our youngest patient was nine months of age. Shaw reported the case of a patient seven weeks of age.

**Symptoms.**—That many errors are made in the diagnosis of appendicitis in infants and young children is in no small measure explained by the fact that the cardinal symptoms, as laid down by writers, viz., vomiting, colic, and sensitiveness to pressure, do not complete the symptomatology. Pain is a relative term, and the complaint of pain, while it must be respected, is never to be relied upon. Some children will exaggerate the sensitiveness of the abdomen to pressure, and others will deny the existence of pain actually present. Vomiting and colic are very unreliable signs. Fortunately in children one sign is almost invariably present unless there is a malformed or misplaced appendix, which is most unusual. This sign of real value indicating an involved appendix in a child is *localized muscle rigidity*—a *spastic right rectus*. This symptom is entirely beyond the child's control, and while young children may be difficult to approach, patience in gaining the child's confidence, combined with attempts at diversion, will make a satisfactory examination possible.

Deep pressure is not necessary. If both recti are persistently rigid, as

<sup>1</sup> Appendicitis in Children, New York Medical Journal, cviii, No. 12, p. 502.

in a few cases, the fact in no way disproves the presence of a diseased appendix. Vomiting, pain, and colic are corroborative when there is a spastic right rectus. Alone they are suggestive of appendicular disease in children, but not diagnostic.

With the rigidity and unusual sensitiveness to deep pressure, there is a tendency to flexion of the thigh on the abdomen, to relieve the tension of the abdominal muscles.

Atypical cases may be seen, and in our experience have most often been due to an abnormally long appendix. Thus, in the case of a boy of twelve years, the appendix was 6 inches long and the abscess was located in the tip, which was in the right hypochondrium. In this case there was general muscle rigidity.

*Illustrative Cases.*—In an eight-year-old child the diseased appendix was situated deeply in the pelvis. There was no pain or rigidity. Appendicitis was not diagnosed until rupture occurred and an acute localized peritonitis developed.

In another child, with a very long appendix, the local symptoms were all referred to the left side. Operation was delayed, through no fault of the writer, until abscess and peritonitis developed. The tip of the gangrenous appendix was located 2 inches to the left of the median line.

*Leukocytosis.*—A leukocytosis is present in practically all cases, the differential count showing 70 per cent. or over of polymorphonuclear cells.

**Prognosis.**—The prognosis depends upon the ability of the physician to diagnose the disease, his courage to act promptly, and the good sense of the family. In the young, appendicitis is usually of the fulminating type, and while temporizing may answer in the adult case it may be fatal to the child. Statistics of high mortality mean defective management. In the treatment of children over two years of age the results should be as favorable as in that of adults. If one uses ice-bags, stupes, and salines for three or four days and then operates, a high mortality is inevitable.

**Diagnosis.**—The chief diagnostic symptom is rigidity of the abdominal muscles, usually localized in the right side, sometimes general. Marked general abdominal rigidity was noted in a girl eleven years of age, whose appendix had not perforated. This symptom, with localized tenderness and the presence of a tumor, is to be looked upon as an independent diagnostic sign. All other symptoms to which much importance is attached are only of corroborative value.

**Differential Diagnosis.**—In cases of intussusception and periodic vomiting there is no definite muscle rigidity, and in periodic vomiting no localized tenderness.

Acute peritonitis may simulate a later stage of atypical appendicitis so closely that a differential diagnosis is impossible without an exploratory incision. This should always be done in either event, whether peritonitis is of the more common origin or is due to intussusception.

Acute pneumonia at the right base, with pleurisy, may produce signs closely simulating appendicitis, and is one of the conditions that may produce a spasm of the right rectus.

In a very typical case operation for removal of the appendix might have been performed had not the patient presented the scar of a previous appendectomy wound.

With pneumonia and pleurisy there are the unmistakable physical signs, the respiratory grunt, high temperature, and usually cough, to-

gether with the objective sign of rapid breathing—signs ordinarily sufficient to eliminate an error in diagnosis. In cases in which the physician feels that a differentiation is impossible the x-ray may be brought into use to clear up the situation.

**Treatment.**—After a considerable experience with obscure acute and chronic abdominal conditions in children we have learned that an exploratory incision should be made as soon as we realize we are not positive regarding the character of the trouble at hand. This has been learned through experiences which we regret. Proved acute appendicitis in children demands operation as early as possible.

For the borderland case, with mild symptoms in which a positive diagnosis is not possible, rest in bed, a fluid diet without milk, and the ice-bag comprise the essentials in a scheme of treatment which may suffice. The recumbent position and quiet should be maintained until every sign of the trouble has disappeared.

**Interval Operation.**—In the event of the child's recovering from a well-defined attack without operation a suitable time should be selected for an interval operation. A second attack is very likely to follow in less than a year, with a strong probability of abscess formation. Furthermore, we cannot time the subsequent attacks, and these may occur with great severity when the child is otherwise ill or away from home where necessary surgical skill may not be obtainable.

### CHRONIC APPENDICITIS

Chronic appendicitis has a very decided entity. It occurs in older children. We have never seen a case before the fourth year. In pediatric consultation practice it is not unusual to find the condition after this period.

**Symptoms.**—The cases usually show one of two groups of symptoms.

A child in apparent health has complained of frequent abdominal pain over a period of several months. If asked to place his hand over the painful area, he will almost always point to the umbilicus. There is no apparent sensitiveness over the appendix, no pain on deep pressure, and no rigidity of the recti. The pain is rarely severe and may occur at considerable intervals. In some cases the abdomen will never feel quite comfortable. There may be diarrhea alternating with constipation, or the stool may be perfectly normal and regular. In other instances unwarranted attacks of acute intestinal indigestion may occur, the occasion of which will not be explained by the habits of the patient.

Another type of case shows periodic, acute manifestations. These include vomiting, fever, and colicky pains, with diarrhea. Two or more attacks during the year are usual. As in the cases of the first type there may be no localization of signs in the abdomen.

**Illustrative Case.**—A badly diseased appendix, as large as an adult index-finger, was removed from such a patient who had complained of no localized symptoms other than a feeling of pressure or weight in the right side, but who always had, as he expressed it, an uncomfortable abdomen.

Periodic or recurrent intestinal disturbances—so-called indigestion—that is not relieved by a rational life and careful feeding will usually

be found due to either an elongated sigmoid (p. 256) or to chronic appendicitis.

According to Comby many cases of cyclic vomiting have their origin in chronic appendicitis, and a considerable number of such cases have been cured by removal of the appendix.

*Illustrative Case.*—Figure 58 is taken from a case of this sort. The patient, a boy eight years of age, had suffered for a long period from persistent stomach disturbance associated with hiccup, belching, and foul breath. He was on a very rigid diet of skimmed milk, simple vegetables, and flesh food. Raw fruit and sweets produced what were called "stomach upsets." The x-ray revealed a large appendix that still contained the bismuth mixture six days after its injection. Operation disclosed a very long chronically inflamed appendix.

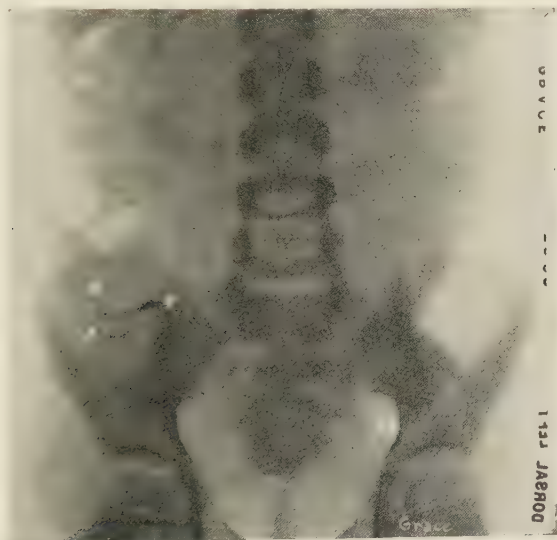


Fig. 58.—Chronic appendicitis. (Retention in the appendix three days after injection, with segmentations which probably represent concretions.)

**Treatment.**—Suspected subjects should be given an anesthetic after fasting for twelve hours, and then examined by deep palpation and through the rectum. If tumefaction is found in the right iliac fossa, operation for the removal of the appendix should be performed at the convenience of the patient.

### ACUTE GENERAL PERITONITIS

Acute general suppurative peritonitis is an infection of the peritoneum by pathogenic organisms. It is always a secondary disease, and its bacterial cause is that of the primary lesion. Thus, peritonitis may follow umbilical infection in the newborn, usually due to the streptococcus or to the *Staphylococcus aureus*, or may result from a general blood infection with the pneumococcus, the typhoid bacillus, the influenza bacillus, or streptococcus, whether the point of entrance be the upper respiratory tract or a surgical lesion. Peritonitis is a common complication of appendicitis, enterocolitis, or intestinal obstruction, and is then most often due to *Bacillus coli communis*, with or without the streptococcus. Peritonitis

also may be due to the gonococcus, as the result of the progressive spread of vulvovaginitis, endometritis, and salpingitis in little girls. Finally, peritonitis may result from the extension of a pleural inflammation by means of the lymphatics, but the inflammation is then more often localized about the spleen or liver than generalized.

The pneumococcus probably is the pathogenic agent in more than half the cases.

An unusual illustrative case of acute peritonitis is recorded under the differential diagnosis of intussusception, p. 279.

**Pathology.**—The exact character of the inflammation depends upon the infecting organism. The process, however, uniformly involves congestion, exudation of serum and lymph, and the formation of adhesions. Depending on the source and degree of infection, peritonitis may be localized, "spreading" or general, and serous, seropurulent, purulent, or fibrinous. The most frequent infecting agents are the colon and the typhoid bacillus and the streptococcus, staphylococcus, pneumococcus, and gonococcus. In cases of streptococcus peritonitis the fluid is thin and widely diffused, and in pneumococcus infections, thick, greenish-yellow, purulent, and associated with fibrinous deposits and many adhesions. Gonococcal peritonitis is seldom diffuse. Pus with a characteristic fecal odor is suggestive of appendical or intestinal perforation. When the peritonitis is of limited extent, the most common sites for the localization of the inflammation are the iliac fossa, pelvis, and subdiaphragmatic regions. Abscesses occasionally perforate spontaneously at the umbilicus. When recovery ensues, the peritoneum frequently becomes the seat of permanent adhesions which may or may not occasion symptoms.

**Symptoms.**—There are but three diagnostic symptoms of value: persistent vomiting, marked tympanites, and obstinate (and often absolute) constipation. These manifestations comprise a symptom-complex that is practically always present in acute peritonitis. Vomiting may be absent in very acute and fatal cases.

The temperature is usually persistently high—103° to 105° F. The pulse is small, soft, and quick, and the child appears and is very ill. The respiration is short and rapid; there is incomplete expansion. There are no evidences of pain except upon manipulation. The onset of all symptoms is usually, but not invariably, abrupt. It may be two or three days before the symptom-complex as described is present.

*Illustrative Case.*—A fine healthy boy four years of age seen in consultation with Dr. Harriet Hyde developed a severe staphylococcus infection of the tonsils. On the fourth day of the illness symptoms of acute peritonitis developed with paralytic ileus and death in a few hours.

**Duration and Prognosis.**—Death rarely occurs before the third day, and the cases that pass ten days are rare. We have never known a case to recover. Our cases have all been those of children under two years of age, with a few exceptions.

*Illustrative Cases.*—A child of three developed a streptococcus infection in conjunction with endocarditis.

Another patient, a strong, vigorous girl, three years of age, developed a moderately severe enterocolitis. Response to treatment was fairly prompt, and in ten days the

child was convalescent. Suddenly she developed marked distention of the abdomen, persistent vomiting, and obstinate constipation. These symptoms, with gradually increasing prostration, continued for three days, when the child died. The autopsy showed an acute general streptococcal peritonitis. Streptococcus was found in the enlarged mesenteric glands, indicating that the intestinal tract was the source of the infection.

Other cases have been those of appendicitis seen too late to forestall the occurrence of perforation.

The prognosis in older children after the fifth year is said to be more favorable.

**Differential Diagnosis.**—The only condition which acute peritonitis may simulate in infants and runabouts is intestinal obstruction, particularly that due to intussusception. Intussusception in a large majority of the cases occurs in infants under a year of age. Further, in intussusception there is no associated illness, and fever, if present, is insignificant; while the stools almost always contain blood-stained mucus or clear white mucus.

**Treatment.**—Every case of acute peritonitis in a young subject should have the benefit of an exploratory incision. There is always a possibility in obscure cases (and many cases are obscure) that the trouble is of appendicular origin or that there may be some other localized process which drainage might relieve. Acute general peritonitis is a very fatal disease, and the outlook cannot be made worse by incision and drainage.

## THE INTESTINAL PARASITES

The most common of the intestinal parasites found in children are *Ascaris lumbricoides*, or round-worm, *Oxyuris vermicularis*, or thread-worm, *Tenia*, or tapeworm, and *Uncinaria*, or hook-worm.

**The Blood in Infections by Intestinal Parasites.**—Patients with teniasis or uncinariasis frequently present a pronounced degree of anemia of the chlorotic type. In occasional cases of tape-worm infection the blood-picture resembles that of actual pernicious anemia. Where uncinariasis is prevalent and the inhabitants are subject to constant infection from the soil, such terms as "Egyptian chlorosis," "miner's anemia," and "brickmaker's anemia" are current synonyms for the disease.

Leukocytosis in the parasitic infections is not characteristic, but may occur during the acute stage of trichiniasis. Eosinophilia, however, is a very characteristic manifestation of reaction to the parasitic toxins, and in trichiniasis often attains a degree of 20 to 50 per cent. Stiles reported that in uncinariasis the chronic cases with poor resistance show little eosinophilia, while those undergoing improvement under treatment afford counts averaging as high as 13.2 per cent.<sup>1</sup>

***Ascaris Lumbricoides* (Round-worm).** This parasite is a very frequent inhabitant of the small intestine. The worm is 5 to 10 inches long, cylindric in form, and closely resembles an ordinary earth-worm. Large numbers may exist in the same patient, and have been known to cause serious secondary symptoms, such as obstruction of the bile-duct or a severe attack of choking, induced by the migration of the worms from the esophagus into the larynx. They have been known to invade the eustachian tube. The ova are taken into the digestive tract in uncooked

<sup>1</sup> Osler's Modern Medicine, vol. i.

food and occasionally in drinking-water. The eggs are of oval form, and when present in the feces may be distinguished by their thick shells and "mammillated" borders and by the absence of segmentation.

*Symptoms.*—The round-worms, if in considerable number, may produce colic or constipation, the latter oftentimes alternating with diarrhea. Nervous disturbances of an urgent character are not uncommon. In the great majority of our cases, however, no single symptom has been prominent, and the fact that the child had parasites in the intestine has been first learned when a worm has been passed by the rectum.

*Illustrative Case.*—A patient, three years of age, had repeated convulsions. The mother stated that the child had passed a couple of round-worms the day before. Following the giving of 1 ounce of castor oil, and after an hour, 2 grains of santonin, 43 large round-worms were passed during the next twenty-four hours. This is the largest number we have known to come from one child.

The round-worm is relatively rare in New York City children. In children who live in the country it is of fairly common occurrence.

*Treatment.*—At bedtime it is well to order from 2 to 4 teaspoonfuls of castor oil. Early the following morning, about two hours before breakfast, santonin is to be given. For children under two years of age a suitable dose is 1 grain; for those from two to four years of age,  $1\frac{1}{2}$  grains; and after the fourth year, 2 grains. The santonin is prescribed in a powder or capsule, with an equal quantity of sugar-of-milk. If the passage of worms follows its use, the treatment should be repeated in three days; and again in a week, if worms are passed after the second treatment.

**Oxyuris Vermicularis (Thread-worm or Pin-worm).**—Thread-worms are of more frequent occurrence in city children than are either round-worms or tapeworms. The thread-worms have their habitat in the lower portion of the colon, where they become attached to the mucosa, and occasionally produce considerable catarrhal inflammation. Exceptionally they may invade the appendix and excite inflammation requiring surgery. The oxyuris is an insignificant looking object, light in color, from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in length, and of the diameter of a pin. The ova are not so large as those of the ascaris. Raw fruit and uncooked vegetables may convey the infection.

*Symptoms.*—The worms produce an irritation and itching about, and a pricking sensation within, the anus. The discomfort is bitterly complained of after the child is in bed at night, the parasites being particularly active at this time. If there is any doubt as to their presence, the patient should receive a full dose of castor-oil—at least 2 teaspoonfuls. The discharges should be kept for inspection. If the parasites are present, they will usually be found embedded in a considerable quantity of mucus, in the form of pieces resembling white thread from  $\frac{1}{4}$  to  $\frac{1}{8}$  inch in length.

*Treatment.*—Santonin, recommended by some writers as of service in these cases, has been without the slightest value in our hands. In fact, the use of drugs of any kind by mouth seems to be of very little value. After the third year turpentine in 1-drop doses after meals is probably the most valuable form of internal medication. It may be given in emulsion or dropped upon sugar.

**Rectal Injections.**—Local treatment with the infusions of garlic or quassia is our principal reliance in the management of the obstinate cases.

When the worms have existed in the bowel for a considerable time the resulting irritation causes a profuse secretion of mucus in the descending colon and sigmoid. This mucus must be washed out before any direct treatment can be effective. The colon should first be irrigated with a solution of 1 tablespoonful of borax to a pint of water. For this purpose a No. 18 American catheter introduced, if possible, 10 inches, should be used, as in colon flushings. The child should be encouraged to bear down and expel the water alongside the tube, no attempt being made to have the solution retained. After the preliminary washing is complete, 8 ounces of the infusion of quassia may be passed into the colon. To facilitate retention of the fluid the tube must be quickly withdrawn. The child may then be placed on the left side, with the buttocks elevated on a pillow. This position, or at least the recumbent position, should be maintained for one half-hour after the injection is given. A solution of bichlorid of mercury 1 : 10,000 may be used in the same way. For ordinary family use, however, the garlic or the quassia is much safer and equally effective. Garlic used in infusion identical with quassia is particularly effective, but its very disagreeable odor makes its use objectionable in many households, and therefore we advise it only when other means fail. After the worms and all evidences of their presence disappear, the treatment should be continued for some time on alternate days, and then twice a week, gradually reducing the frequency of the irrigations until they are no longer required. Few cases recover in less than four weeks, and in many instances it will be found necessary to continue the treatment for months. We have never seen a case, however, which did not eventually respond to persistent treatment.

**Tenia (Tapeworm).**—The tapeworm is a long, flattened organism, consisting of a head or scolex and hundreds of individual proglottides or offshoots derived from the head. Each segment in the series contains a large number of eggs. After the discharge of the segments from the body these ova are ingested and undergo a period of development in the tissues of an intermediate host, eventually forming the cysticerci or encapsulated bladder-worms which give the “measle” appearance to infected meat. This meat, when insufficiently cooked, conveys the cysticercus to the stomach of the patient, where the digestive juices liberate from the cyst wall a head which is capable of becoming attached to the mucosa of the child’s alimentary tract and producing a mature parasite.

The chief varieties of tapeworm are *Tænia saginata*, or beef-worm, *Tænia solium*, or pork-worm, *Bothriocephalus latus*, an inhabitant of fish, and *Tænia elliptica*, which passes an intermediate stage in the vermin of household pets.

*Tænia saginata* attains a length of from 12 to 20 feet. The head is from 1 to 2 mm. in diameter, and contains four suckers, but no hooklets.

*Tænia solium* is rarely over 12 feet long. The offshoots from the median canal forming the uterus of a segment show less branching than in the case of *Tænia saginata*, and the developed segments in *Tænia solium* are more nearly square. The head has a short rostellum with a circle of hooklets.

*Bothriocephalus latus* is far more common in northern Europe than

in America. When mature, this worm is over 25 feet long. The segments are unusually broad, and the head is oval in outline and contains two lateral grooves.

*Tania elliptica* occurs occasionally in very young infants. It is only 6 to 12 inches in length, and its segments are long and narrow.

*Symptoms.*—The tapeworm may produce symptoms of disturbed intestinal digestion, such as colicky pain and diarrhea. Usually, however, the first warning that the child is affected is afforded by the passage of segments of the worm.

*Illustrative Cases.*—A worm 14 feet in length was expelled, after treatment, by a little girl four years old. There had never been a symptom of its presence other than the passage of several of the segments.

A child eighteen months of age passed 18 feet of a tapeworm without dislodging the head.

*Treatment.*—At bedtime  $\frac{1}{2}$  to 1 ounce of castor oil is to be given, and early next morning, two hours before breakfast,  $\frac{1}{2}$  dram of the oleo-resin of male-fern (*aspidium*), in emulsion or in capsule. During the day a light fluid diet only should be allowed, such as broth, gruel, and fruit juices. One treatment with a good preparation of the male-fern will usually bring away the worm entire. The head should be carefully searched for with the magnifying-glass. If the head is not found, the treatment should be repeated after an interval of twenty-four hours.

**Uncinaria (Hook-worm).**—The two forms of this parasite, *Ankylostoma duodenale* and *Uncinaria americana*, exhibit certain morphologic differences, the most marked of which is the existence, in *ankylostoma*, of two pairs of ventral, hook-like teeth, which are not present in the American species. The hook-worm measures from  $\frac{1}{4}$  to  $\frac{3}{4}$  inch in length. The ova, in large numbers, are present in the feces, and may be recognized as small oval bodies, usually clear in appearance, about  $50 \times 30\mu$  in size, showing various stages of segmentation. After the administration of thymol, followed by a saline cathartic, the worms themselves may appear in the stools as small objects, a little thicker than a pin, about  $\frac{1}{2}$  inch long, and with the characteristic, retroverted hooked end.

The hook-worm has been known for many generations, but only during the past twenty years has uncinariasis received due attention. In certain localities—notably the West Indies and the Southern States—the soil is very generally infected, and a considerable proportion of the population harbor the parasites. These not only remove blood from the circulation of the victim, but elaborate a toxin which is thought to assist in the causation of the significant anemia of this disease. Infection usually takes place from the soil, through the skin of bare feet. Infection may also take place through the skin of the hands, or by means of the gastro-intestinal tract, through the eating of raw fruit or vegetables.

*Symptoms.*—The symptoms are those of digestive disturbance combined with progressive anemia. The anemia is often of an extreme degree. Abdominal discomfort of considerable degree may exist and this possibly gives rise to the curious habit of earth-eating, which these patients may acquire in their desire for the relief which the ingestion of food usually affords. Stiles reported a case in which a boy ate three coats, thread by

thread, in twelve months. As the disease progresses, the face and ankles may become edematous. The stools contain occult blood. Lassitude and incapacity for sustained effort are prominent symptoms, and unless the cause of the disease is eliminated, the child falls behind in both physical and mental development.

*Treatment.*—Thymol is specific for the hook-worm. A purgative should precede the administration of the drug. Twelve hours before administering the thymol a full dose of cascara sagrada or Epsom salts should be given. The thymol should be given in solid form, 5 to 10 grains every three hours, until four doses have been given. The drug is best given in capsules or pills. Twelve hours after the last dose a saline cathartic should be administered. Ten days after the administration of the thymol the stools should again be examined for the ova of the parasite, and if ova are found, the treatment should be repeated. Thymol poisoning is indicated by dizziness and discoloration of the urine. When these symptoms appear, the treatment should be discontinued and further purgation brought into use. During the active treatment the diet should consist of milk, broths, and gruels.

The anemia and malnutrition should be managed along the lines suggested under the respective headings.

**Trichiniasis** is a disease which children may occasionally acquire from the eating of uncooked ham, sausage, or pork. In localities where meat inspection is rigid cases of this infection are relatively rare. *Trichina spiralis* (*Trichenella spiralis*) is not infrequently found in hogs. The female parasite deposits larvæ in the submucosa, whence they are carried by the lymphatics to the blood-stream, and on reaching the voluntary muscles become encapsulated. When the uncooked, infected meat is eaten the capsules undergo dissolution, and the contained trichinæ are liberated in the digestive tract of the patient. The forms attain full development in the small intestine, and about a week after the ingestion of the meat set free a new brood of embryos.

Van Cott and Lind<sup>1</sup> found the *Trichina spiralis* in the cerebrospinal fluid. These findings have since been confirmed by Young, Cummins, and others. In doubtful cases an examination of the cerebrospinal fluid serves as a means for the possible confirmation of a diagnosis.

*Symptoms.*—The severe symptoms of trichiniasis develop about ten days after the eating of the infected meat, frequently following a period of preliminary gastro-intestinal disturbance. When well advanced, the disease may be mistaken for typhoid, malaria, influenza, nephritis, or acute rheumatism. Fever of a remittent type, great muscular pain and soreness, and edema of the face and eyelids suggestive of nephritis are the more pronounced effects. The blood shows not only leukocytosis, but a marked grade of eosinophilia. The symptoms usually subside after a week or ten days. Romanowitch demonstrated that in traversing the intestinal mucosa the trichina deposits bacteria which may distribute secondary infections. How important this fact may be in the explanation of symptoms occurring in this disease remains to be determined. In doubtful cases trichiniasis may be diagnosed by the microscopic demonstration of the encapsulated parasites in a bit of muscle tissue removed

<sup>1</sup> Jour. Amer. Med. Assoc., vol. lxvi, No. xxiv.

under local anesthesia from the deltoid, biceps, or gastrocnemius of the patient.

*Illustrative Case.*—A girl eight years of age developed muscle soreness, edema of the skin, and especially marked swelling and stiffness of the muscles of the left leg. Trichiniasis was suspected, and a small portion of the deltoid was removed, which showed the encapsulated parasite.

*Treatment.*—At the outset of the disease thorough catharsis is of unquestionable value, for it has been estimated that “each female parasite removed from the intestine means a reduction of the muscular infection by from 1500 to several thousand worms.”<sup>1</sup> Calomel is undoubtedly indicated for this purpose, and this drug should be given in doses aggregating 1 to 2 grains, accompanied by 10 to 20 grains of bicarbonate of soda, and followed after six hours by a saline cathartic. Thymol may be given in the manner suggested under treatment of uncinariasis, but the position of the parasites deep in the intestinal mucosa renders most of them secure from the action of an anthelmintic. After the disease has become established the treatment is solely symptomatic, consisting in the use of means to relieve pain, control temperature, and support the pulse, which in severe infections may become weak.

<sup>1</sup> C. W. Stiles, Osler's Modern Medicine, vol. i.

## IX. THE RECTUM AND ANUS

### THE RECTUM IN CHILDREN

In the child the division between the pelvis and abdominal cavities is less marked than in the adult, and the rectum is less distinctly a pelvic organ. The infantile pelvis, moreover, is peculiarly narrow, so that the course of the terminal portion of the intestine is nearly perpendicular. This peculiarity, combined with the greater mobility of the child's rectum, renders digital examination per rectum of great value in palpating diseased organs within the abdomen. The same anatomic conditions, associated with weakness of the levatores ani, are influential in the causation of prolapsus recti in children.

### IMPERFORATE ANUS—ATRESIA ANI

The greater portion of the alimentary tract is derived embryologically from entoderm, but the caudal part is formed from the elevation of a fold of ectoderm which surrounds a crater-like hollow called the proctodeum. This latter ectodermal invagination is separated from the entodermal gut till about the fourth week of fetal life by the anal membrane, a portion of the cloacal membrane. Cases of imperforate anus or atresia ani may be due to a complete or partial persistence of this membrane so that the proctodeum or external invagination does not communicate with the caudal portion of the hind-gut or is connected with it only through an abnormally small opening. Other causes of imperforate anus may be:

- (1) Deficient development of the hind-gut so that there is an interval between the gut and the proctodeum.
- (2) The rectum may open into the vagina, uterus, bladder, or ureters.
- (3) Persistent cloaca.

### PERSISTENT ANAL MEMBRANE

Slight or moderate constriction of the anal ring due to partial persistence of the anal membrane is a fairly common cause of constipation, colic, and difficulty in defecation in small infants. On careful digital examination a tight membranous ring may be felt at the level of the external sphincter. Frequently the gut above is empty and ballooned up with gas which is violently expelled upon withdrawal of the examining finger. The ring should be gently dilated. One such dilatation may suffice; more often it has to be repeated once or twice till the distention, colic, constipation, and difficulty at stool is relieved. Complete persistence of the anal membrane necessitates its being broken down to permit the free passage of feces. The other forms of imperforate anus require more extensive and more difficult surgery.

The rectum of every newborn infant who suffers from the symptoms described should be digitally examined with the purpose of determining the presence of this small membrane. This may at times account for very urgent symptoms.

### PROLAPSE OF THE ANUS AND RECTUM

In anal prolapse there is an eversion of the mucous membrane, a condition often presented in constipation and sometimes seen in diarrheal conditions of the dysenteric type, in which there is a tendency to considerable tenesmus and straining. If the case is neglected, the prolapse occurring repeatedly for many days in succession in cases of constipation, or several times a day in the acute diarrheal cases, the sphincter gradually becomes weakened, the prolapse more pronounced, and soon a considerable portion of the involuted rectum appears with each defecation. Children thus affected usually show evidence of illness apart from the local condition and the constipation. They are usually underfed and poorly nourished. Many are rachitic, or show the evidences of a previous rachitic state.

**Treatment.**—Cases of simple eversion are usually relieved by controlling the diarrhea; or, when due to constipation, by supporting the perineum during defecation. This support is best furnished by wrapping a considerable quantity of absorbent cotton around the index-finger, which rests against and supports the perineum. The child should lie on the back during defecation. The troublesome cases are those due to constipation in "runabout" children, in whom the prolapse has been repeated every day for several months. In such cases a wide adhesive strip placed across the buttocks, high enough to permit of bowel evacuation, will prevent the prolapse.

### INFLAMMATION OF THE ANUS

An acute painful inflammation of the anus and of the skin surrounding it is frequently seen in children after a diarrhea of some days' duration. It is also seen in weakly, delicate children without any marked intestinal disturbance. The inflammation produces considerable distress during the passage of a stool, and is conducive to constipation, because the child soon dreads to have a bowel movement and tries to avoid it.

**Treatment.**—The child's nutrition and management in general must be first carefully looked after, as elsewhere suggested (p. 140). For the local trouble the free use of warm water after each defecation is necessary. This is to be followed by a generous application of an ointment made as follows:

R. Ichthyolis.....	3j
Unguenti aquæ rosæ.....	3j.—M.

Instructions are given that the parts are to be kept covered with the ointment, applied on a piece of old linen, which should be changed every three hours. This treatment is usually followed by prompt relief.

### FISSURE OF THE ANUS

Anal fissure is a condition that usually occurs in quite young children. Comparatively few cases have been personally seen in children over two years of age. Rough manipulation may be a cause, as in the case of unskilled use of the syringe or rectal tube. With very few exceptions, however, the fissure is due to the stretching of the parts by the passage

of large fecal masses, which cause minute lacerations of the mucous membrane within the anal ring. Under a good light gentle separation of the buttocks will usually bring the laceration into view.

**Symptoms.**—There are few more painful affections. The vigorous crying preceding and during the defecations aids the mother in locating the source of the child's trouble. Occasionally the fecal mass will be streaked with blood. The constipation which causes the trouble is aggravated by the painful nature of the condition, as the child soon learns to dread an evacuation, and postpones the act until medication or some manipulation is employed to induce a movement.

*Illustrative Case.*—A little girl, twenty months old, was brought for treatment because she cried and objected to being placed in position for a bowel evacuation, and cried even more during the evacuation. On the day preceding the office visit the mother feared the child would have a convulsion so great was her distress. Examination of the rectum showed two rather small fissures extending through the anal mucous membrane.

**Treatment.**—*Diet.*—For a prompt repair of the fissures it is necessary to render the stools soft. This, in the bottle fed, is often easily accomplished by the addition to each feeding of 1 or 2 teaspoonfuls of one of the malted foods, such as Mellin's food or malted milk. In other instances one feeding of malted milk each day may be substituted for one of the regular feedings, in the strength of 4 to 6 teaspoonfuls in 8 ounces of water.

*Drugs.*—If drugs are necessary or are preferred, the addition of 2 teaspoonfuls daily of the milk of magnesia to the milk food will prove of value. A teaspoonful of sweet oil after two or more feedings will likewise usually have the desired softening effect upon the stool.

*Local Measures.*—Proper regulation of the bowel function, while absolutely necessary for a cure of the laceration, is not of itself sufficient to effect permanent relief. The parts must be thoroughly washed with warm water and Castile soap after each defecation. After the washings, and at three-hour intervals during the day, 25 per cent. of ichthyol-ammonium-sulphate in zinc ointment should be applied with a clean index-finger, which is introduced well up into the anal aperture. If the fissure is deep, the treatment should be begun by applying to the parts a solution of novocain. The fissure may then be cauterized with 50 per cent. solution of nitrate of silver, applied on a cotton-tipped probe. Twelve hours later the ichthyol ointment may be used as in the milder cases.

## PROCTITIS

Inflammations of the rectum are of three different forms—catarrhal, croupous or membranous, and ulcerative.

*Catarrhal proctitis* is usually associated with colitis higher in the bowel. When confined to the rectum, the process may be due to the careless use of irrigations or irritating suppositories, or the activity of thread-worms.

The mucous membrane is red and swollen, and exudes not only mucus, but a small amount of blood. In gonorrheal proctitis, which occasionally complicates a vulvovaginal infection by the same organism, the discharge from the inflamed parts is characteristically purulent.

*Membranous proctitis* may result from diphtheria of the genitals or

from a local streptococcus infection. The morbid lesions closely resemble those of membranous colitis, and are not essentially different from those which occur in membranous inflammations of the throat. The grayish, organized exudate may be visible on the mucosa of the prolapsed bowel, or appear in fragments in the stools.

*Ulcerative proctitis* is usually secondary to a severe catarrhal proctitis, in which case the lesions tend to remain superficial. Follicular ulcers of greater depth may occur in connection with follicular colitis. Syphilitic and tuberculous ulcerations of the rectum are rare. Holt reported one case of the tuberculous type, and recorded Steffen's observations of three others.

**Symptoms.**—In all forms of proctitis the movements of the bowels are frequent, and associated with tenesmus and the discharge of mucus and small amounts of blood. Prolapsus recti is not uncommon, and after reduction shows a strong tendency to recur so long as the severe peristaltic activity of the bowel persists. The character of the discharge is of value in differentiating the existing type of inflammation.

**Treatment.**—In mild cases of the catarrhal form injections of warm starch solution, alkaline liquid antiseptics, or sweet oil will effect a cure, provided the primary cause of the irritation has been removed. When the process is diphtheric, antitoxin should be promptly administered, as in cases of laryngeal diphtheria.

Ulcerative proctitis requires especial care involving the use of cleansing irrigations and suppositories of tannigen, belladonna, opium, or cocain, combined with local application, at intervals, of a solution of silver nitrate of from 2 to 5 per cent. strength. For the gonorrheal cases Koplik has advised rectal injections of 2 per cent. protargol solution, at a temperature of 105° to 108° F., twice daily.

#### ISCHIORECTAL ABSCESS

An abscess of this nature is the result of preceding adenitis of the lymph-glands in the neighborhood of the rectum.

**Symptoms.**—The first sign will be that of pain on defecation or upon manipulation. Upon examination an oval, indurated mass will be found under the skin, usually not deeply placed. Much pain is evidenced during the examination. In most instances there is redness of the skin over the involved gland. Rarely can fluctuation be made out by palpation. Suppuration, however, follows the primary infection very rapidly, and a distinct area of reddened and inflamed skin indicates the presence of pus beneath. Children's hospitals, children's asylums, and dispensary services supply the majority of these patients. Occasionally a case is seen in private work.

**Treatment.**—All that is required is a free incision, daily washing out of the abscess cavity with a 3 per cent. solution of hydrogen peroxid, and packing with sterilized gauze moistened with a saturated solution of boric acid. A layer of gauze, covered with oiled silk, should cover the dressing, to protect the wound from further infection by the fecal discharges. In case the granulations are sluggish, as they may be in maramic infants, the gauze used for the packing may be saturated with balsam of Peru.

## X. DISEASES OF THE LIVER

### ABNORMALITIES OF FUNCTION AND SIZE

THE liver in infants and children is very rarely the seat of primary disease, and in the mortality of childhood as an immediate cause plays a very unimportant rôle.

**Derangement of function** of the organ, on the other hand, is unquestionably at the bottom of many disorders not at all understood at the present time. In conditions of toxemia, particularly in so-called acidosis, the failure of normal oxidative processes on the part of the liver constitutes a most serious phase in the altered metabolism of the body. The organ may be enlarged temporarily or permanently from various causes. One of the most common is congestion induced by cardiac insufficiency. Active hyperemia may be induced by indigestion. In rickets and syphilis and in various diseases of the spleen and lymph-glands the liver is persistently enlarged.

**Fatty change in the liver** in early life is often found at autopsy. It is found in greater or less degree in practically all infants and young children who die from prolonged and exhausting diseases.

Presumably the infiltration is of a temporary nature, and, so far as is known, has no symptomatology of its own. In many cases that recover the liver must have undergone not only fatty infiltration, but a considerable degree of fatty degeneration. It is rare not to find more or less fatty change at a postmortem examination of a child under one year of age. In some cases the involvement is so extensive that the entire organ is firm, smooth, and of a yellowish color. In other cases there are only localized evidences of the fatty process. Usually the organ is not enlarged. The condition is not to be diagnosed during life. If there is a derangement of function, this is not of such a nature as to make the actual hepatic conditions manifest.

**Acute Yellow Atrophy.**—Fatal cases of this disease in children are reported at rare intervals.

### ABSCESS OF THE LIVER

In the newborn abscess is the result of an infection usually acquired from the umbilical veins. Several cases in older children have been reported, in which the abscess was caused by the migration of round-worms into the hepatic duct.

Abscess of the liver may result from any pyemic condition. Its rare occurrence demonstrates the hepatic powers of resistance against microbic invasion.

*Amœba coli* has been the cause of abscess in a considerable number of cases.

**Symptoms.**—Enlargement of the organ, associated with the presence of marked tenderness, is usual. Pain is a very constant symptom, and may be referred to different points in the abdomen, not infrequently

being felt at the umbilicus, or localized between the right scapula and spine. Among the most prominent active manifestations are repeated chills, a widely ranging septic temperature, and vomiting. Occasionally there is diarrhea.

Exploration should be performed, and if pus is located, aspiration and drainage should follow. Abscesses not operated upon are apt to perforate into the peritoneal or pleural cavity. Cases of perforation into the intestine have been followed by recovery.

### CIRRHOSIS OF THE LIVER

Cirrhosis of the liver belongs to the curiosities of pediatric practice. All the cases reported represent, roughly speaking, the observations of as many men.

In the reported cases in which there has been a supposed etiologic factor, syphilis, alcohol, and the infectious diseases have been looked upon as the agencies causing the disease.

Toxic substances of widely different character are apparently capable of causing cirrhosis of the liver in the young. The possibility of cirrhotic changes occurring as the result of prolonged absorption of toxins from fermentative processes in the intestine must be considered as in certain instances of adult cirrhosis.

**Symptoms.**—At first there is enlargement of the liver and the spleen. Persistent but not severe icterus and ascites supervene. The patient shows early evidences of malnutrition, and a cachexia that is strongly suggestive of the underlying condition. As the case progresses the liver becomes very much reduced in size, diarrhea becomes fairly constant, vomiting frequent, and dilatation of the superficial abdominal veins occurs. Bronchopneumonia is the usual terminal complication.

**Treatment.**—The management is entirely symptomatic. Abdominal paracentesis may temporarily relieve the embarrassed respiration and the general discomfort occasioned by the large amount of fluid in the abdominal cavity.

### BILIARY COLIC

Older children have paroxysmal pain and exhibit persistent jaundice.

*Illustrative Case.*—A girl eight years old, the child of a physician, had suffered from permanent jaundice of three years' duration, with intermittent attacks of colic followed by an increase in the intensity of the jaundice. Operation revealed a large calculus in the common duct.

### ICTERUS (OBSTRUCTIVE JAUNDICE; CATARRHAL JAUNDICE)

Jaundice of this type in children is usually associated with duodenitis, and is caused by a swelling of the lymphoid bodies in the mucous membrane of the common bile-duct at its terminal opening into the intestine. The jaundice is due probably to the same form of infection that caused the duodenitis. Cases often occur in groups of two or three in the same family.

*Illustrative Cases.*—In November, 3 children and 2 adults—the mother and nurse—had pronounced jaundice with the usual manifestations. Six weeks before all these people had suffered from malaria.

We have seen but one case in which jaundice was due to cholelithiasis. This

patient, a girl six years of age, had distinct attacks of biliary colic, accompanied by passage of gall-stones and followed by intense jaundice. She was eventually operated upon and many stones were removed from the gall-bladder.

**Symptoms.**—The onset is almost never marked by high temperature or evidence of severe gastric disturbance. Usually the first signs are loss of appetite, coated tongue, rise of a degree or two in temperature, and listlessness. The yellow discoloration of the conjunctiva and skin soon appears, and this, with the high-colored urine and slightly colored or grayish stools, makes the case complete.

The liver is usually enlarged an inch or two below the ribs, and often is slightly tender. The spleen is also slightly enlarged.

We have never known a fatal case, although such have been reported.

**Vomiting.**—In a most severe case the vomiting continued for five days, neither food nor water being retained. Vomiting is present in most cases. The child vomits two to three times, or at intervals for a day or two.

**Treatment.**—*Diet.*—The reason why gastric disorder is considered so prominent a symptom by many writers is possibly because of the gastric disturbance produced by the treatment. We are advised to place the patient on a milk diet and give calomel. We know of no treatment better calculated to produce vomiting and increase both the intestinal infection and the jaundice. The treatment which has been found most satisfactory is simply the use of very little food for twenty-four hours. Water is given as a drink, and later, well-salted chicken or mutton broth may be given with toast if the child asks for food. He should not be urged to eat. The following day broths, gruels, and orange juice, with stewed fruits or lemonade, may be given if wanted.

*Drugs.*—The only medication used consists of rhubarb and soda. To a child five years of age 4 grains of pulverized rhubarb and 8 grains of bicarbonate of soda may be given from two to three times daily, together with considerable water. For a day or two sufficient medicine should be given to produce a free laxative effect, but not necessarily enough to purge the patient. Usually on the third day it is advisable to begin with tincture of nux vomica and dilute hydrochloric acid—from 2 to 4 drops of each, well diluted. When the stools are again normal, the usual diet may be resumed, milk not being used for a week afterward. Rhubarb and soda are best given as follows:

R.	Pulveris rhei . . . . .	gr. xlviii
	Sodii bicarbonatis . . . . .	gr. xcvi
	Syrupi rhei aromatici . . . . .	ʒj
	Aquæ . . . . .	q. s. ad. ʒij
M.	Sig. Shake well. One teaspoonful two or three times daily after meals.	

Other measures to hasten the disappearance of the jaundice are daily irrigations of the bowel and the administration by mouth of phosphate of soda in water before meals, the dose being determined by the effect obtained. To most children the effervescent preparation is the more palatable.

For a fortnight after the acute symptoms have abated a diet should be maintained that is relatively fat free. Eggs and top milk particularly should be excluded.

## XI. DISEASES OF THE RESPIRATORY TRACT

### THE NOSE AND THROAT

#### ACUTE RHINITIS (CORYZA; SNUFFLES; COLD IN THE HEAD)

ACUTE rhinitis is a very common ailment throughout childhood. Newborn babies, "runabouts," and school children alike are sufferers. The so-called cold in the head is unquestionably an infection and may be transmitted from the diseased to the well. That a specific causative micro-organism has not been demonstrated in no way invalidates this statement. One repeatedly sees an acute rhinitis develop in one member of a family and pass through the entire household of perhaps six or eight persons, adults and children. Infants and young children should not come in contact with other persons suffering from such conditions.

**Symptoms.**—The onset is usually sudden, and characterized by sneezing and difficulty in breathing through the nose. This may continue for a few hours or, in some cases, for a day or two. At the expiration of this time a mucous, watery nasal discharge appears. Infants are the greatest sufferers, owing to the fact that breathing, which has to be carried on largely through the mouth, is rendered difficult, and nursing, in consequence, is frequently interrupted. A degree or two of fever may exist at the commencement of the attack, but any elevation of temperature, as a rule, lasts only a few hours. Neglected cases frequently become infected with pyogenic bacteria (staphylococcus, pneumococcus, and streptococcus), in which event a troublesome purulent rhinitis results. In the majority of the neglected cases, and in some of those that are well treated, the rhinitis is the beginning of an infection of the mucous membrane, which involves successively the fauces, tonsils, larynx, and bronchi. Repeated attacks doubtless contribute to the production of adenoid growths in the nasopharyngeal vault. Otitis media is not an infrequent outcome, particularly if the child has adenoids.

**Differential Diagnosis.**—Acute simple rhinitis is to be differentiated from specific rhinitis, which is one of the first manifestations of congenital syphilis. When due to syphilitic infection the condition is uninfluenced by the usual treatment. There is no tendency for it to descend and involve the mucous membrane of the bronchi. The hoarseness of congenital syphilis is persistent and of gradual development. Furthermore, if the rhinitis is due to syphilis, other diagnostic signs are present or will soon appear.

Measles almost invariably begins as an acute rhinitis. The accompanying conjunctivitis, the hard, dry, hacking cough, and the characteristic rash soon make the diagnosis possible. In nasal diphtheria there is invariably a discharge from the nose which may be differentiated from that of simple rhinitis by the fact that the discharge in diphtheria is excoriating in character and is often tinged with blood. A diphtheric discharge may be limited entirely to one nostril or may be greater from one nostril than the other; while in acute simple rhinitis the amount

of the discharge is usually the same from both sides. Influenza begins with sneezing and nasal discharge, serous in character. In influenza, however, there is associated cough, fever, and more or less prostration.

**Duration.**—The tendency of acute simple rhinitis in a strong child is toward recovery in five or six days. When the surroundings are unfavorable, or the child is delicate or rachitic, active treatment will be required to bring about a prompt recovery.

**Complications.**—Simple rhinitis is very often the beginning of an infection which may reach the middle ear and produce purulent otitis or mastoid disease. Cervical adenitis is not an infrequent outcome. Retropharyngeal adenitis and retropharyngeal abscess, acute laryngitis, bronchitis, and bronchopneumonia may all result from acute rhinitis. Early treatment and care of the primary condition are, therefore, exceedingly important.

**Treatment.**—The first step is the administration of 2 teaspoonfuls of castor oil. During the initial stage of engorgement much may be accomplished for the very young by local medicaments. One of the best is menthol,  $\frac{1}{2}$  grain, dissolved in 1 ounce of liquid petrolatum. Of this solution 3 drops should be instilled into each nostril every hour by means of a medicine-dropper. This treatment alone will relieve the patient of distressing obstruction and facilitate freer breathing. Older children may use a spray containing 1 grain of menthol to 1 ounce of liquid petrolatum at intervals of two or three hours.

In case menthol and petrolatum are not at hand, melted white vaselin may be similarly employed.

For internal use the following medication has served well.

At least six doses should be given in the twenty-four hours.

For a child three months of age:

R. Tincturæ belladonnæ..... gtt. vii  
 Pulveris camphoræ..... gr. iv  
 Sacchari lactis, q. s.  
 M. div. et ft. tabellæ No. xxx.  
 Sig.—One tablet every two hours.

Six months of age:

R. Tincturæ belladonnæ..... gtt. x  
 Pulveris camphoræ..... gr. v  
 Pulveris ipecacuanhæ et opii..... gr. iv  
 Sacchari lactis, q. s.  
 M. div. et ft. tabellæ No. xxx.  
 Sig.—One every two hours in water.

From one to two years of age:

R. Tincturæ belladonnæ..... gtt. xv  
 Pulveris camphoræ..... gr. vj  
 Pulveris ipecacuanhæ et opii..... gr. x  
 M. div. et ft. tabellæ No. xxx.  
 Sig.—One every two hours.

From two to four years of age:

R. Tincturæ belladonnæ..... gtt. xv  
 Pulveris camphoræ..... gr. vj  
 Pulveris ipecacuanhæ et opii..... gr. xv  
 Sacchari lactis, q. s.  
 M. div. et ft. tabellæ No. xxx.  
 Sig.—One every two hours.

If for any reason the tablets cannot be prepared, powders will answer the purpose equally well.

The above prescriptions are indicated for the second or catarrhal stage, in which we usually find the patient on beginning treatment. We must guard against the constipating effects of the camphor and the Dover's powder.

In the treatment of nasal disorders the forcible use of the syringe, or any form of nasal irrigation which requires force, should be condemned. Infection is easily carried into the eustachian tubes, and may give rise to very grave complications. A suppurative otitis is thus very easily produced.

An enema of warm sweet oil or soapsuds should be administered if the bowels do not move once in twenty-four hours. In treating children of a markedly constipated habit the Dover's powder may be omitted. Internal medication, if begun early and properly carried out, will not be needed for more than two or three days.

During an attack of acute rhinitis the child should not be unnecessarily exposed to cold, owing to the strong tendency of the inflammation to descend and involve the deeper portion of the respiratory tract. Notwithstanding the undoubted good effects of open-air treatment in certain forms of pneumonia much harm is often done to children with incipient colds affecting the upper air passages by injudicious exposure to open window drafts in inclement weather. Caution in this respect will insure the proper procedure in a given case.

#### CHRONIC RHINITIS (NASAL CATARRH)

Nasal discharge, more or less constant, is present in not a few individuals throughout childhood. In the majority of those affected this discharge begins with the onset of cold weather and lasts until spring. The secretion may be composed of thin, watery mucus, or it may be mucopurulent in character.

**Etiology.**—In order to treat this condition successfully the source of the discharge must be discovered. It may be due to several causes, which are here given in the order of their frequency:

1. Adenoids in the nasopharyngeal vault.
2. Hypertrophy of the turbinate bones, with septal deviations and hypertrophy of the mucous membranes.
3. Infection due to pyogenic bacteria. When present, this may follow acute rhinitis, but is more often the sequel of one of the infectious diseases. The discharge may be distinctly purulent and is often very profuse.
4. Infection due to the Klebs-Löffler bacillus. A great many cases of this type in children under eight years of age have been observed, in which a serous discharge from one or both nostrils has persisted for a considerable period of time—in one instance for an entire year. Examination of the discharge shows the presence of the Klebs-Löffler bacillus. Such children are not ill, and are brought to a physician solely for treatment of the nasal discharge. The cases do not clear up under ordinary methods of treatment, but promptly respond when from 1500 to 2000 units of diphtheria antitoxin is given.

5. Hay-fever is characterized by a periodic discharge which may be said to be chronic in character, persisting over several weeks.

6. Malnutrition. A thin, watery discharge, apparently due to relaxed mucous membranes, occurs in weak and poorly nourished children with no other abnormal condition to explain the trouble than the general weakness.

7. Disease of the sinuses. Sinus infection of a mild type may cause persistent rhinitis without other symptoms, and these cavities should be examined in obscure cases.

8. Foreign bodies. A foreign body in either nostril will produce a persistent discharge. When a child is brought to us with a history of a persistent serous or purulent discharge from one nostril, we invariably examine for a foreign body, and repeatedly have found this discharge explained by the presence of a pea, a bean, a piece of coal, or a button.

*Illustrative Case.*—At the Out-patient Department of the Babies' Hospital a child three years of age was brought for treatment of a persistent right-sided nasal discharge which had existed for seven months. Examination showed a foreign body well up in the nostril. This object was removed with considerable difficulty and proved to be a piece of cork.

In these cases of chronic rhinitis the possibility of adenoids (see p. 322) should never be forgotten; for their existence cannot be excluded because a child is not a mouth-breather and does not snore. A chronic "cold in the head" almost invariably indicates the presence of adenoid vegetations in the nasopharyngeal vault. Examination may reveal that the nasopharyngeal space is blocked by the growth, so that entrance with the finger is almost impossible. In other instances only a small, pulpy mass will be found, or a ridge of soft, friable growth at the upper portion of the vault, not large enough to produce signs of obstruction, but actively secreting and manifestly the source of the discharge. Children who have anterior nasal defects, such as hypertrophies of bone or thickening of the membranes, usually have adenoids as well. In fact, adenoids play no small part in most of the catarrhal affections of the upper respiratory tract in children, and an examination of a child with a nasal discharge or a cough which is difficult to explain is never complete without an exploration of the nasopharyngeal vault.

**Treatment.**—The treatment consists in correcting the condition which causes the discharge. If adenoids are present in a sufficient amount to cause trouble, they should be removed (p. 325). No other treatment is of any avail. For deformities and hypertrophies of the anterior nasal structure operative measures are also essential, but should be carried out by one skilled in rhinoplastic work. Purulent rhinitis, primary or following the infectious diseases, is advantageously treated by a spray composed of liquid petrolatum, 1 ounce, ichthyol ammonium sulphate, 2 grains, the mixture being thoroughly shaken before using. This spray should be used every two hours while the child is awake. Once or twice a day it may be well, if the secretion is profuse and purulent, to instil into the nostril about 20 minims of a 1 : 6 aqueous solution of hydrogen peroxid. If the Klebs-Löffler bacillus is present, antitoxin alone will control the disease, and that very promptly.

The anemic and poorly nourished patients, who show almost no ab-

normality, but suffer more or less from a constant serous discharge, are benefited by constitutional measures only—a dry climate, plain, nourishing food, iron, cod-liver oil, massage, and salt baths. Suitable management is referred to in detail under *The Treatment of the Sub-normal Child* (p. 140). Applied to such children, local treatment, apart from cleanliness, is a loss of time and energy.

### NASAL HEMORRHAGE

Non-traumatic nasal hemorrhage in a child usually occurs from one of two sources—adenoid vegetations in the nasopharyngeal vault or an erosion or ulceration of the mucous membrane covering the free vascular area of the anterior portion of the nasal septum.

**Treatment.**—Hemorrhage due to adenoid growth is usually readily controlled by keeping the child in an upright position, or by the application of cold to the back of the neck—preferably by a piece of ice wrapped in a table napkin or by an ice-bag. When the hemorrhage is due to an erosion of the septum and pressure of the finger on the outer side of the bleeding nostril is found ineffective, the nostril may be packed with cotton saturated with a 5 per cent. solution of antipyrin or a 1 : 2000 solution of adrenalin.

For permanent relief, and to prevent a recurrence of the hemorrhage, adenoids should be removed and an excoriated or ulcerated septum cauterized with a 50 per cent. solution of silver nitrate. If the ulcer is first cleaned with plain water, ordinarily but one or two applications of the silver solution will be required. Spraying the affected side with a 1 per cent. solution of ichthyol in liquid petrolatum will hasten the healing process. As the ichthyol is not soluble in the oil, the mixture should be well shaken before using.

### PERSISTENT COUGH

We have had occasion to examine and treat many children who were brought to us because of a "cough" which had not been controlled by the measures employed. The history is usually only that of a persistent cough. This may be irritating in character, keeping the child awake at night, or it may be paroxysmal, the attacks being more severe when the child is lying down. Many times the paroxysms are so severe, particularly at night, that in the absence of chest signs, whooping cough is suspected.

**Types of Cough.**—While we hear much of the cough of teething, the "stomach cough," the "nervous cough," and the "habit cough," it has never been our lot to see a case in which the cough was not connected in some way with the respiratory tract. Thorough examination of these cases, perhaps repeated examinations, will be required before the site of the trouble is definitely located. Then it will invariably be found somewhere between the anterior nares and the diaphragm. The "stomach cough," the "nervous cough," or the "teething cough" frequently referred to by the older writers stood for the persistent cough which could not be accounted for by physical examination of the chest or by mere inspection of the throat.

An adherent pleura and enlarged tonsils without adenoids are ac-

countable for a very small number of these cases. An elongated uvula, to which these obscure coughs have also been attributed, is very rarely a cause.

*Adenoid Vegetations.*—An immense majority of these obscure coughs in children are due to adenoid vegetations, with or without enlarged tonsils. A child with such a cough may have the typical adenoid face, mouth-breathing, and other signs referred to (see Adenoids, page 323), or these symptoms may be entirely absent. It is the latter type of case that is particularly puzzling and apt to be overlooked. On account of the absence of mouth-breathing and other symptoms of nasal obstruction, the possibility of adenoid vegetations is often ignored. In these cases careful inquiry will usually elicit the history of frequent colds, or what is styled "catarrh" (as there is more or less serous discharge from the nose), or the statement that the child "takes cold in the head easily." Digital examination of the nasopharyngeal vault will reveal a fringe of soft adenoid growth at the upper portion of the posterior pharyngeal wall, not large enough to produce obstruction, but actively secreting. This secretion, if not profuse, is partially evaporated in the nostrils, or if profuse, is discharged from the nostrils or passes backward over the posterior pharyngeal wall, thus provoking cough, when the child is up and about. When the child rests on his back, the secretion naturally flows over the posterior pharyngeal wall, and induces cough. Time and again one may relieve the most obstinate cough by cureting and removing this sponge-like tissue.

*Illustrative Case.*—In the case of one patient, a boy two years of age, who had been coughing hard for ten days with paroxysms and vomiting, a diagnosis of pertussis had been made both by a member of the family who had seen many cases of whooping-cough, and also by the writer. Adenoids were found to be present in a slight degree. Their removal was accomplished, with the idea of making the coughing attacks less severe, when, greatly to our surprise, the coughing ceased at once, not a paroxysm occurring after the growth was removed. The cough was due to the adenoid vegetations and not to pertussis.

*Adherent pleura*, non-tuberculous, as previously mentioned, is occasionally a cause of persistent cough. Autopsies upon children who have died with non-respiratory diseases often show these pleuritic adhesions, which are not suspected during life.

*Illustrative Case.*—A girl twelve years of age was brought because of a persistent cough. The child was otherwise well and gaining in weight. She had been treated with expectorants, cod-liver oil, and the usual other medication, without avail. The cough remained unchanged and was influenced only by opiates. A very careful physical examination revealed friction râles, covering an area the size of a half-dollar, at the base of the right lung, adjacent to the spine. They were heard only on forced inspiration and had been overlooked in the previous examination. The case had been diagnosed as one of "nervous cough."

*Tracheal Cough.*—Tracheitis will produce a severe and intractable cough, with no signs in the chest. These cases frequently follow attacks of true influenza, or the cough may be present during the active period of the disease. If the child is old enough, he will aid us by referring to the sense of discomfort and tightness which exists over the upper portion of the chest. Sometimes the sensation will be described as a burning which is located directly over the trachea.

*Enlarged Mediastinal Glands.*—Children with enlarged tracheobronchial lymph-glands are particularly subject to persistent cough which frequently assumes a spasmodic, even sneezing type strongly suggestive of pertussis. At times the adenitis is tuberculous, but not infrequently it is the result of prolonged bronchitis or bronchopneumonia of the influenzal or streptococcic type, one of the characteristic late results of such infection being considerable peribronchial thickening.

In identifying enlargement of glands in the midchest region prolonged slight elevation in temperature, percussion dullness, and a positive D'Espine sign are of significance, but the most reliable aid is afforded by the *x*-ray combined with the intradermal tuberculin test.

Irrespective of the exact nature of the infection the treatment most effective is the placing of the patient in a climate where sunshine predominates and colds are infrequent.

*Tuberculosis.*—Incipient tuberculous infiltration in any portion of the lungs or pleura may produce persistent cough. Thorough physical examinations and careful observation of all the cases, with the intradermal test, will make a diagnosis possible.

*Pertussis* without the whoop or vomiting may cause a persistent cough, spasmodic in character. It runs its course and subsides in from four to eight weeks. A diagnosis is possible only when there is a history of exposure to the disease, or when another member of the family has an unquestionable attack.

*Foreign Body Cough.*—This type of cough has been given the importance which is its due by the notable work of Chevalier Jackson and his followers, which has demonstrated beyond argument that in all cases of unexplained cough the presence of a foreign body in the air passages must be considered until the existing facts are shown by *x*-ray examination. The facts are not always apparent to the untrained interpreter even with the aid of the *x*-ray, but the whereabouts not only of opaque but of transparent objects, such as peanut kernels and seeds, may be detected by the expert.

Upon the removal of the foreign body by the aid of the bronchoscope the focus of inflammation in the lung (often in spite of previous long duration) usually undergoes spontaneous resolution and the cough ceases.

Many children have been wrongly called tuberculous for lack of discernment by their physicians in cases of respiratory obstruction from foreign bodies. (See *Foreign Bodies in the Air-passages*, p. 818.)

The treatment of the various conditions producing cough is referred to under the respective headings.

#### THROAT EXAMINATION

In order to examine the throat of a young child quickly and thoroughly it is necessary that he be held in a proper position in front of and at the right side of the attendant, supported by her left arm beneath the buttocks. Her right arm, which is thus left free, is passed around the child, binding his arms to his sides. The child's head rests against the shoulder of the attendant. The physician places his left hand on the child's head to steady it, and with the tongue-depressor or teaspoon in his right hand, with the child in perfect control, presses the tongue downward so that it will not obscure the field of vision. In handling an older and

stronger child, it is best to bind the arms to the sides with a large towel or small sheet. The most satisfactory view can be obtained by daylight before a window. If the examination is made in the evening, a lamp or taper held by a third person, a little above and behind the attendant's right shoulder, will furnish satisfactory illumination. The head-mirror should be used for children who are too ill to be taken out of bed, the reflection from a lighted lamp or candle being sufficient. The various electric devices which may be carried in the pocket are very useful.

### FAUCITIS

By the term "faucitis" we understand an inflammation of that portion of the mucous membrane of the buccal cavity situated posteriorly to the soft palate and the anterior pillars of the fauces, including both the anterior and posterior pillars, the tonsils, and the pharyngeal vault. The inflammatory process is superficial, involving the mucous membrane only, so that the tonsils are involved only to the extent of the mucosa.

Faucitis is always present in scarlet fever, usually to a marked degree. In measles it is also present, but less intense in its manifestations. Its most frequent appearance is in connection with a summer cold. Every year, in late May and June, we are called upon to treat many such cases.

The *symptoms* always comprise cough, which is dry and ineffective, and a slight fever—from 100° to 101° F. The child complains of sore throat, and has some discomfort on swallowing. Upon inspection an intense inflammation will be noticed, involving the entire visible mucous membrane. In many cases the inflammation extends downward and involves the larynx, which fact will be indicated by the hoarse, croupy character of the cough. The condition is usually the result of a mixed infection, with the streptococcus predominant. The entire illness is ordinarily of three or four days' duration.

**Treatment.**—The condition is best relieved by a purgative of rhubarb and soda—3 grains of powdered rhubarb and 3 grains of soda for a child from two to five years of age. To a child under two years of age 1 to 3 grains of rhubarb and 1 to 2 grains of bicarbonate of soda may be given. This, in the case of a child from one to three years of age, is followed by a tablet or powder of tartar emetic, 1/90 grain, powdered ipecac, 1/60 grain, and chlorate of potash, 1 grain, at two-hour intervals. Older children, three years and over, receive 2 to 3 grains of chlorate of potash, 1/90 grain of tartar emetic, and 1/40 grain of ipecac at two-hour intervals—six doses in twenty-four hours.

### SIMPLE PHARYNGITIS

Inflammation limited to the posterior pharyngeal wall is of rather infrequent occurrence in young children. When thus affected, the parts present a reddened, granular appearance. In the cases which have come under our observation such a condition has always been associated with digestive disturbances. The tongue is usually coated and the breath foul. A dry cough and frequent attempts at clearing the throat are the usual symptoms. The temperature is rarely above 101° F. The condition is to be distinguished from the pharyngitis which occurs as a result

of microbic infection, in that only the posterior wall is involved. The tonsils and pillars of the fauces and the soft palate present a normal appearance.

**Treatment.**—The treatment is to reduce the diet for a few days to cereal gruels—barley, rice, or wheat—and chicken or mutton broth. Calomel, 1/10 grain, with 1 grain of rhubarb, given after feedings, three times a day for three days, will often promptly relieve the condition.

### THE TONSILS

Anatomically, the lymphoid structures in the pharynx, termed “tonsils,” consist of several groups. Of these, the faucial and pharyngeal structures are clinically of most importance.

The *faucial tonsils* are situated one on each side of the oropharynx, between the anterior and posterior pillars of the fauces. The tonsil is roughly ovoid, and in early life about 2 cm. thick, the longest measurement being the vertical diameter. The inner surface presents many depressions or crypts. These are most numerous in the upper portion. Above the organ there is a larger depression called the supratonsillar fossa. This frequently serves as a pocket for the development of suppurative inflammation. On its outer surface the tonsil is covered by a fibrous capsule, from which the reticulum of connective tissue supporting the lymphoid structure is derived. In close relation to this surface is the ascending palatine artery. The internal and external carotid arteries are normally about 2 cm. distant, but as a result of inflammation and hypertrophy in the tonsils, these vessels may be less remote. Branches to the organs are derived chiefly from the ascending pharyngeal and facial arteries, but also from the lingual and descending palatine. Hemorrhage following operations arises principally from the ascending palatine, the ascending pharyngeal, and tonsillar branches of the facial. Operative wounds of the carotids are very rare.

The *pharyngeal tonsil* is a single structure, occupying the posterior-pharyngeal wall. According to Piersol, without being markedly hypertrophied, it may encroach upon the nasopharyngeal space.

The *tubal tonsils* and the *lingual tonsils* are developed respectively at the eustachian orifices and over the posterior third of the tongue. Scattered collections of the same tissue unite with the larger masses described, and form an irregular guardian-ring encircling the upper part of the pharynx.

### ACUTE FOLLICULAR TONSILLITIS

Tonsillitis consists in an inflammation of the mucous membrane and glandular structure of the tonsil.

**Age.**—No age appears to be exempt, the condition at times developing in infants three or four weeks old. The great majority of the cases, however, occur between the second and twelfth years.

**Etiology.**—Tonsillitis is due to a mixed infection, usually with the streptococcus predominating. The disease is exceedingly infectious, and frequently occurs in epidemics.

**Predisposition.**—One attack predisposes to another by preparing a suitable culture-field in the crypts. Children in whom lymphatism is prominent, and whose glandular structure possesses a poor resistance, are the most susceptible.

**Pathology.**—The tonsils undergo considerable enlargement, and the crypts become filled with exudate consisting of epithelial detritus, mucus, pus, and bacteria. Occasionally the exudate covers the surface of the organ in the form of a pseudomembrane similar in appearance to that occurring in diphtheria. The pathogenic bacteria most frequently present are the streptococcus, staphylococcus, and pneumococcus. Of these, the streptococcus is so frequently a cause of the inflammation that in many epidemics the term "tonsillitis" has been superseded by the convenient designation, "streptococcus sore throat." When the cellular infiltration in the depths of the tonsil becomes extreme, suppuration and abscess-formation, combined with severe edema of the peritonsillar tissue, is not uncommon. If the discharge of such a collection of pus is not spontaneous or else obtained by early incision, complete destruction of the parenchyma and the formation of a retropharyngeal abscess may result.

**Symptoms.**—The onset of tonsillitis is usually sudden and may be attended by a chill. In a few of our cases an attack has been ushered in by convulsions. However, the usual mode of onset is with fever— $101^{\circ}$  to  $103^{\circ}$  F.—headache, loss of appetite, and muscular soreness. Young children may show difficulty in swallowing, and older children may complain of pain in the throat. Not every case of tonsillitis, however, is characterized by the existence of such pain. Inspection shows that the tonsils are swollen and reddened and perhaps covered with scattered, light-colored, cheesy deposits. In some instances the local signs consist only of the swelling and redness; in other cases the cheesy deposit exists as an early manifestation. The spots of exudate may remain distinct and single, or they may coalesce, forming a pseudomembrane. During the attack the patient feels decidedly ill, and often gives evidence of considerable prostration. The temperature ranges from  $103^{\circ}$  to  $105^{\circ}$  F. Slight swelling may occur in the lymphatic glands at the angle of the jaw, but this is usually absent. In a comparatively small percentage of cases the associated adenitis is very pronounced. A great deal of tenderness of the glands, with a sore throat, is a suspicious sign, and should lead one to examine very carefully for diphtheria.

**Duration.**—An uncomplicated attack of tonsillitis lasts from three to five days. If the temperature continues for a longer period than six days, the possibility of complications should be considered.

**Prognosis.**—The prognosis is favorable. When uncomplicated, the disease is never fatal.

**Complications.**—Cervical adenitis, otitis, peritonsillar abscess (quinsy), and retropharyngeal abscess are the most frequent secondary conditions. Infrequent complications are arthritis, endocarditis, pericarditis, and pyemia. Acute nephritis is occasionally a sequel of tonsillitis and is apt to assume a hemorrhagic character.

**Differential Diagnosis.**—Tonsillitis must be differentiated from tonsillar diphtheria. There are few harder problems, and, in fact, in many cases, early in the attack, the solution is impossible without a bacterio-

logic examination. The following characteristics of the average case of each of the two diseases may aid us in differentiating:

*Tonsillitis*.—Onset sudden; fever high at onset—102° to 105° F. Glands at the angle of the jaw swollen slightly, if at all. Exudation, follicular, appearing as small dots; may form membrane through coalescence.

*Tonsillar Diphtheria*.—Onset gradual; fever usually low at onset, 100° to 102° F. Lymphatic glands at the angle of the jaw considerably swollen. Membrane present on the tonsil appearing in thin, grayish layers which gradually become thicker and more extensive.

*Mixed Infection*.—A case of mixed infection may at first present the picture of typical tonsillitis. The temperature may vary from 103° to 105° F. Pain upon swallowing, prostration, and loss of appetite may exist together with a follicular exudation. Such a case may remain stationary for twenty-four to forty-eight hours. The dots then coalesce, forming a firm membranous deposit, the lymph-nodes at the angle of the jaw enlarge; and, in short, both the clinical manifestations and the bacteriologic examination show that we have to deal with a case of diphtheria.

These cases of diphtheria which are preceded by a clinical tonsillitis are probably the most dangerous. The primary condition is diagnosed as tonsillitis, and for several days is considered to be only a tonsillitis in spite of the membranous deposit which later forms. This delay in making the diagnosis gives abundant opportunity for the exposure of other children, and postpones the use of antitoxin, rendering the remedy, when finally given, of little or no avail. The only safe rule is to consider as diphtheric every case in which there is a pseudomembrane on the tonsils, and to treat such a case with antitoxin without waiting for a bacteriologic examination. Furthermore, when there are other children in the family, one should invariably isolate every case of simple tonsillitis.

**Treatment**.—Local treatment of the diseased parts in tonsillitis by spraying, swabbing, and painting has been of very little service in our hands, particularly in dealing with children under four years of age. When the patient is held by force for such treatment, thoroughness is impossible, and little or nothing is accomplished. For tractable children and those old enough to understand what is being done, gargles, sprays, and irrigations are useful in so far as they relieve pain and cleanse the diseased parts. A useful gargle is the following:

R.	Sodii salicylatis,	
	Sodii biboratis,	
	Sodii bicarbonatis.....	āā gr. xlv
	Essentiæ menthæ piperitæ.....	ʒj
	Aquæ.....	q. s. ad. ʒij

M. Sig.—One teaspoonful in one-half glass of water at 115° F. Gargle entire quantity every hour.

A useful spray is the following:

R.	Acidi borici.....	gr. lx
	Aquæ menthæ piperitæ.....	ʒviij

M. Sig.—Spray throat every two hours.

In severe tonsillitis associated with much swelling and consequent tension, the pain upon swallowing is often excruciating. Irrigation of

the throat is indicated not only for purposes of cleanliness, but because of the relief from pain which it affords.

The technic recommended is described on page 321. The child with simple tonsillitis may receive the irrigation sitting erect. If found acceptable this may be repeated in four to six hours.

It is advisable to begin the general treatment with a laxative. One grain of calomel, in divided doses of  $\frac{1}{6}$  grain every fifteen minutes, answers well. The food should be reduced. For a bottle-fed patient one-half the quantity of the usual milk mixture should be given, diluted with an equal quantity of water. The fever, if high, may be readily controlled by cool sponging.

The only drug which has appeared to possess any signal value for internal use in tonsillitis is chlorate of potash given in the dosage of 1



Fig. 59.—Cold compress in position.

grain at two-hour intervals for a child one year of age; 2 grains at two-hour intervals for a child two years of age—16 grains in twenty-four hours; 3 grains at the same interval for a child three years of age—24 grains in twenty-four hours. We rarely give more than 3 grains at two-hour intervals at any age, although we have never been able to associate the action of the drug with kidney complications in any of hundreds of cases. This drug is usually given in solution with simple elixir and water or syrup of raspberry and water.

Children who have repeated attacks of tonsillitis should have the tonsils enucleated regardless of their size, as diseased tonsils are portals of infection and a source of ever-present danger.

Cold compresses (Fig. 59) applied to the throat are of aid to older children, who can appreciate the necessity of this measure. This form

of treatment is described in detail under the management of acute catarrhal laryngitis. (See p. 333.)

### PERITONSILLAR ABSCESS (QUINSY)

The seat of a peritonsillar abscess is in the cellular tissue about the tonsil, and the condition is due to an invasion of the parts by pathogenic bacteria, among which the streptococcus is most frequently present. The source of the infecting agent is almost invariably a tonsil more or less diseased. The abscess may form above, in front of, or behind the tonsil. Quinsy is usually preceded by recognizable tonsillitis. In none of our cases has the abscess followed diphtheria, scarlet fever, or measles.

**Symptoms.**—The child has tonsillitis with the usual symptoms, and, in addition, greatly increased swelling of the throat and pain upon swallowing. He complains of pain in the muscles of the neck on the affected side, and holds the head toward that side. A fairly early symptom is inability to open the mouth to the usual extent. In the average case inspection reveals a reddened, edematous swelling, slightly above and in front of the tonsil, causing a forward displacement of the uvula. Exceptionally, when the swelling develops posteriorly, the tonsil is displaced forward and appears unduly prominent. A case of this type is very apt to be overlooked unless a digital examination is carefully made, when a soft, fluctuating swelling will readily be felt behind the tonsil. Speech is interfered with, and the act of swallowing is carried out with great discomfort. Young patients will go for several days with little or no nourishment because of the pain occasioned by the taking of food.

**Treatment.**—The treatment is incision. This step, however, should not, as a rule, be taken until the abscess is fully developed. If the incision is made too early, it not infrequently becomes closed and requires reopening. This closure sometimes occurs even after a timely operation, because when too small an incision is made, the contraction of the abscess wall necessarily following the free discharge of pus and blood effectually closes the opening.

In exceptional cases the development of dyspnea may be rapid, and in such instances prompt incision over the most prominent part of the presenting swelling must be made even though the actual location of pus is not demonstrated. If the scalpel penetrates to sufficient depth and the incision is enlarged with an artery clamp relief afforded will justify this more radical course, whereas delay might necessitate tracheotomy.

For operation the patient should be wrapped in a large towel or sheet with the arms securely bound to the sides. He should sit in an upright position on the lap of the attendant, against whose right shoulder his head rests. The left arm of the attendant is passed around the patient, holding him firmly, while the right hand grasps his forehead. A Denhard gag of the O'Dwyer set may be used to hold the mouth open. Either by the use of reflected light from a head-mirror, or with the patient facing a window, the operator, using a guarded bistoury, makes a free incision in the abscess from above downward. The escape of a considerable amount of blood usually follows the withdrawal of the knife. Frequently more blood than pus is discharged. This is particularly apt to be the case if

the abscess is opened early. The use of light ether anesthesia is at times desirable, in which case the child's head must be kept low and turned to one side to prevent aspiration of the liberated pus, and consequent asphyxia.

It is interesting to note that the cases which open spontaneously rarely heal spontaneously. After a free incision it is advisable during daily visits immediately after the operation to prevent a closure of the wound by passing into it a director, moving this up and down to break up any beginning granulations. With free, uninterrupted drainage the patient is usually well in from three to five days.

With the exception of a saline laxative, which should be given early in the attack, internal medication is valueless. Two drams of Rochelle salts or 6 ounces of a solution of citrate of magnesia may be ordered. Other treatment is directed to the comfort of the patient. An ice-bag applied externally before operation may be acceptable. Our greatest means of relief, however, is afforded by the use of the hot saline irrigation, and the hot gargle where practicable. But few children can gargle well, however, so that ordinarily this measure is best dispensed with. With the few cases where it is practicable, the following prescription and method has been of service:

R. Sodii bicarbonatis.....	gr. xlv
Essentie menthae piperita.....	℥j
Aqua.....	q. s. ad. ℥ij

M. Sig.—Add 1 teaspoonful to 6 ounces of water at 120° F. and gargle entire quantity every half-hour.

The pain occasioned by gargling is another objection to its practice by children. The more effectual means of relieving pain, which causes no effort nor distress whatever, and gives astonishing relief, is a saline irrigation prepared and given as described on page 321.

The irrigation may be repeated every hour and may be used as well after as before operation. When once the child experiences the relief afforded, there will be no trouble in repeating the irrigation.

### VINCENT'S ANGINA

In Vincent's angina there is an ulceration of the tonsil of varying size which may involve the whole tonsil or a very small portion. The shape of the ulcer is irregular with overhanging edges in advanced cases, in appearance not unlike a syphilitic lesion. The ulcer is of varying depth, usually not more than  $\frac{1}{4}$  inch at the deepest part. The sloughing base gives the appearance of a membranous deposit.

In mild cases in which the ulcerative process is slight the lesions may present only the appearance of grayish cobweb-like patches.

**Etiology.**—Vincent's angina is an infection in which two forms of parasites may be isolated, one a fusiform bacillus and the other a spirillum. They are always associated. These are also found in many cases of ulcerative stomatitis.

The bacillus is a slender rod measuring from 6 to 12  $\mu$  long, pointed at each end, Gram negative, and is not motile. The spirillum generally has from three to ten convolutions, is actively motile, and Gram negative.

The organisms sometimes appear in a mixed infection with diphtheria. They may be cultivated anaerobically on ascitic agar at 37.5° C.<sup>1</sup>

**Symptoms.**—The symptoms are not at all severe, usually a slight rise in temperature, 100° to 102° F., with perhaps moderate swelling of the lymph-nodes on the affected side. There is often an accompanying stomatitis which may be the trouble for which the physician is consulted. That there is an involvement of the tonsil is first discovered during the examination of the patient. Very severe and fatal cases have been reported, but these are surely very unusual.

**Diagnosis.**—The case may resemble diphtheria sufficiently to require that a culture be made. A differential diagnosis is usually readily made by a microscopic examination of a smear from the ulcer.

**Treatment.**—The medical treatment is the same as for tonsillitis. If there is adenitis, a cold compress (p. 333) should be applied. Locally, tincture of iodine, peroxid of hydrogen, or a weak watery solution of salvarsan applied twice daily to the ulcer appears to shorten the duration of the disease.

### SEPTIC SORE THROAT (MILK BORNE)<sup>2</sup>

Epidemic sore throat due to an infection conveyed by milk has been of frequent occurrence in England for a number of years.

Since the Boston epidemic in 1911, visitations of the disease have been reported from various sections of this country. Doubtless outbreaks had previously occurred, but had not been recognized. In a recent epidemic of 40 cases there was a mortality of 15 per cent.

**Age.**—All ages are susceptible, the greatest number of cases occur among the young.

**Etiology.**—In the Boston epidemic of 1911 it was first conclusively demonstrated in this country that septic sore throat is a distinct clinical entity due to the streptococcus conveyed in a polluted milk supply. During this time, and at subsequent outbreaks, an examination of the milk source led to the discovery of an epidemic of mastitis existing among the cows supplying the infected community, pus-cells being found on several occasions in the milk. That the dairyman acting as a human carrier is also a factor in infecting the milk has been proved by the existence of a number of cases of sore throat among dairy employees, one of whom (in an epidemic) supplied an abundant growth of almost pure streptococci.

**Pathology.**—A general redness may be diffused over the pharynx, tonsils and soft palate, simulating the aspect of a scarlet fever throat. Small isolated patches of exudation in the tonsillar crypts may make the condition resemble an acute follicular tonsillitis. Later an extensive pseudomembranous exudate may strongly suggest diphtheria. Both tonsils may be involved simultaneously, but more frequently one is infected before the other. The cervical lymph-nodes are always involved to some extent and occasionally very much swollen, undergoing suppuration in the severe cases. The extension of the inflammation to the deeper tissues about the neck often leads to diffuse cellulitis of that region.

<sup>1</sup> Tunncliffe, Jour. of Infec. Dis., 3, 1906.

<sup>2</sup> Herman Biggs, New York Medical Record, 1915.

**Symptoms.**—The onset of the septic sore throat is fairly uniform in its manifestations, being usually sudden and attended by a chill. Nausea is also a frequent accompaniment of the early stages. The temperature rises rapidly to 103° or 105° F., and in the more toxic cases there is general muscular pain and soreness and severe headache. A marked degree of prostration is present in the severe cases. The first period of the disease lasts from three to five days. Rapid recovery may follow or complications which may be numerous and dangerous may ensue and prolong the duration indefinitely.

**Complications.**—Cervical adenitis with possible suppuration, and otitis media are the most frequent secondary conditions in the young. Peritonsillar abscess, nephritis, polyarthritis, pneumonia, and peritonitis are occasionally seen, especially in those more advanced in years.

**Prognosis.**—The prognosis is better in children and young adults than in those who are older, due to the fact that the young enjoy a comparative freedom from the complications. The mortality in recent epidemics according to the literature has varied from 2 to 5 per cent.

**Prophylaxis.**—Pasteurization of all milk used for drinking purposes will prevent the disease. Dairy employees should be under careful medical supervision.

**Treatment.**—The treatment suggested for tonsillitis should be carried out, together with throat irrigation and supportive measures.

#### IRRIGATION OF THE THROAT

**Indications.**—In cases of peritonsillar abscess, retropharyngeal abscess after operation, or sloughing ulcerative processes in the throat, such as we see in diphtheria rarely, but with comparative frequency in scarlet fever, irrigation of the throat with hot normal salt solution is of distinct therapeutic value. The relief to the pain, particularly in quinsy before operation, is sufficient to warrant this treatment. Those who have thus treated the fetid, sloughing throat of scarlet fever, for example, need no argument as to the possible advantages. Gargling is a measure of very limited usefulness even for those children who do it well, for the reason that the solution employed scarcely comes in contact with the post-pharyngeal wall and the lateral faucial structures. For a great majority of older children, and all young children, such a method is practically useless so far as the cleansing of the deeper faucial structures is concerned.

Cervical adenitis, acute, suppurative, or chronic, is usually the direct result of throat infection. Acute suppurative otitis is almost always due to throat infection. An important means of preventing these conditions, with their distressing consequences, is an effective throat toilet. Often in scarlet fever not a small part of the systemic infection after the third or fourth day is through the throat. The irrigation should be done two or three times a day as follows:

**Procedure.**—The child is wrapped in a sheet, which is securely pinned, binding his arms to his sides. He rests on his right side, without a pillow. Directly under his mouth is a pus-basin to catch the outflow. A new fountain syringe, containing a hot salt solution, 120° F., is suspended about 3 feet above the child's body. The largest size of the hard-rubber rectal tip is fastened to the pipe and the tip is placed between the

child's teeth. The current, interrupted every few seconds, should be forcible enough to increase its efficacy as a cleansing agent, the volume of fluid being so small that no inspiration of the water occurs.

The first irrigations will arouse more or less rebellion on the part of the patient, and but  $\frac{1}{2}$  pint of the solution need be used. With older children no trouble will be experienced after the relief afforded by the first irrigation is appreciated. In treating refractory young children, from two to four years of age, the assurance that there will be no pain and a promise of reward, will reduce the struggling to a minimum. It is not to be expected that the child will not cough; in fact, a moderate amount of coughing is desirable, as it dislodges the pus and sloughing tissue, allowing the solution to cleanse the parts more effectually.

### ADENOIDS

The importance of adenoid growths as a cause of nasal obstruction has been appreciated only during the past thirty years. The vegetations were first described by Dr. Wilhelm Meyer, of Copenhagen, in 1868.

**Etiology.**—In proportion to the population, the growths are as frequent among the wealthy and well-to-do as among the poorer classes. In fact, if the throats of all children were carefully examined with the finger, adenoid vegetations in the nasopharyngeal vault would be found in 95 per cent. of the cases. This, however, does not mean that 95 per cent. of children should have the adenoids removed, as in some instances the growth is very small and fairly innocent.

We find adenoids not only in the delicate and ailing but also in the strong and well. Among hundreds of cases few are seen in which a part in the production of the growths can be attributed to lymphatism.

The fact that adenoids are so generally prevalent among all classes and conditions of children points to common causative agencies:

First: There is a tendency to overgrowth of lymphoid tissue in all children.

Second: The location of the normal lymphoid tissue in the pharyngeal vault subjects this tissue to the irritation of dust and sudden currents of cold air, resulting in the pathologic changes described.

Third: The first and second conditions prepare the parts for the action of the third factor—infection.

A curved probe tipped with sterilized cotton when passed into the adenoid tissue of any child, whether the amount of tissue is small or large, will afford a culture of the secretion, in which may be found the streptococcus, staphylococcus, pneumococcus, influenza bacillus, and many other pathogenic organisms. The local congestion caused by the presence of hordes of bacteria further increases the hypertrophy of the adenoid mass.

**Heredity** is of no immediate consequence. If a new race of children could be born free from adenoid antecedents, they would just as surely develop the growths.

**Age.**—If a child passes the fourth year without adenoids, he will probably not acquire them later. Children are born with adenoids. At what period *in utero* they develop is not known. They may be seen

at birth in infants with cleft-palate. Adenoids were present, in quite considerable amount, in one infant who was one month premature. Signs of the growths do not ordinarily develop before the end of the first year. The great majority of cases come under observation between the eighteenth month and the fifth year. At times, however, it is necessary to operate upon infants in order to give relief from growths which almost completely block the nasopharyngeal vault.

**Pathology.**—Hypertrophied adenoids exist as overgrowths of the lymphoid tissue normally present in the nasopharynx. When the lymphoid elements alone are increased, the growths are soft and spongy, but when, as is frequently the case, there is marked development of fibrous tissue, they are firm and resistant. Increase in the connective tissue is primarily a perivascular process. Ultimately atrophy of the lymphoid tissue occurs, resulting in contracture of the adenoid mass. This change has been commonly attributed only to late childhood and early adult life. Such changes, however, are not uncommon in the very young. The spontaneous abatement of symptoms which is so frequently observed in young adults is more probably due to increase in the capacity of the epipharynx than to actual diminution in the size of the obstructing mass.

**Symptoms.**—Some children have large, roomy nasopharyngeal vaults, while in others, on account of the high palatal arch and the prominence of the bodies of the vertebrae, this space is very small. In the latter cases a very small amount of adenoid tissue causes marked obstruction. The character and amount of the growth likewise determine the degree of inspiratory impairment and the severity of the related symptoms.

**Mouth-breathing.**—In all cases showing a considerable growth, and in others in which a moderate growth exists in a small vault, mouth-breathing occurs because the natural respiratory tract is partially blocked.

**Rhinitis.**—A more or less persistent rhinitis is also present, and this is intermittent—now better, now worse. It is usually worse during the winter. During the summer in some cases it may disappear, only to return with the first cold weather. In other cases, with considerable adenoid growth, the nasal discharge never ceases, but is apt to be worse during the winter and spring months. The child cannot blow the nose, the voice and speech are defective, and the voice has a nasal quality. Certain letter sounds, such as “n” and “m” in the words “spring” and “climb,” are pronounced with difficulty. Because of the presence of the mechanical obstruction in the natural respiratory passage, the child breathes through the mouth not only when awake, but when asleep, consequently snores, and is noisy and restless, tossing about and assuming all sorts of awkward positions during sleep.

**Adenoid Face.**—These children all have the characteristic adenoid face. The term “mouth-breathing” does not describe the condition apparent in a pronounced case in an older child. The masseters become so relaxed that a habitual *drop jaw* results. The nostrils are usually small; the nasolabial folds are deepened.

**Adenoids Without Facial Deformity.**—In a child with a roomy vault, adenoids in small or medium-sized masses may be present without producing facial deformity or obstructive symptoms.

Apart from the characteristic appearance of the patients two symptoms in particular suggest adenoids:

First: Persistent rhinitis, indicated by habitual nasal discharge, which is ascribed to a chronic cold.

Second: Cough, habitual, mild, or severe. It may be paroxysmal, often being confused with whooping-cough. (See p. 311.) The cough is always worse when the patient is lying down. Many of these cases pass unrecognized, adenoids being unsuspected because of the absence of obstructive signs, while the cough is attributed to the stomach, dentition, worms, nervousness, etc.

**Diagnosis.**—The open mouth (see Fig. 60), the snoring at night, the stupid expression, the disturbed articulation, the persistent nasal



Fig. 60.—Adenoid face.

discharge, the deafness, the inability to blow the nose, the cough, and the chronicity of the symptoms all combine to make a picture afforded by no other condition.

**Method of Examination.**—In children, after the fifth or sixth year, satisfactory examination by means of mirrors and illumination is occasionally possible. Occasionally a rhinologist will state that he is able to make all necessary examinations in much younger children by means of posterior rhinoscopy. We have never seen this actually demonstrated.

Although such procedure is disagreeable to the patient, we prefer the finger examination in all cases. The child is securely held by an attendant, with the arms pinned to the sides. A mouth-gag or tongue depressor is then placed between the teeth, at right angles to the jaw, and held in

position by the left hand of the examiner, thus allowing the right finger to be free for the examination.

**Association with Enlarged Tonsils.**—In the very young, adenoids usually exist independent of enlargement of the tonsils. The older the child, the more frequent is the involvement of the tonsils. Enlarged or diseased tonsils without adenoids are found only with the greatest rarity.

**Treatment** other than by operation is highly ridiculous.

### HYPERTROPHIED AND PERMANENTLY DISEASED TONSILS

Chronic enlargement of the tonsils is usually the result of repeated attacks of tonsillitis. Notwithstanding this fact, we have repeatedly seen enlarged tonsils which had never been clinically recognized as inflamed. A tonsil is considered abnormally large when it extends beyond the pillars of the fauces. Enlarged tonsils not only produce mouth breathing, faulty articulation, and catarrh of the eustachian tube, but are doubtless a factor in the etiology of adenoids.

Without being enlarged a tonsil may still exist as a menace to the owner. The very small tonsil which is badly diseased, and the small, deeply buried tonsil, largely covered by the pillars, are sources of great danger. In the crypts—whether the organ is large or small—are harbored myriads of bacteria capable of producing repeated attacks of acute inflammation. The streptococcus, staphylococcus, colon bacillus, pneumococcus, the tubercle bacillus, and the Klebs-Löffler bacillus all abound. The crypts of diseased tonsils unquestionably may supply the infective agent in pericarditis, endocarditis, nephritis, anemia, and the various toxemias classified under the broad term of "rheumatism." Adenitis, both tuberculous and simple, is very rare in children who do not have foci of disease in their throats or teeth.

**The Necessity for Operative Interference in Cases of Diseased Tonsils and Adenoids.**—The simple indication to relieve mechanical obstruction is by no means the sole criterion in advising operative measures. Diseased tonsils are responsible in no small degree for many of the complications attending other diseases. In influenza, diphtheria, scarlet fever, and measles the throat always shows active participation. A child free from adenoids and diseased tonsils presents greatly increased resistance to all these diseases; and complications in such children, particularly as relates to the lymphatic glands and ears, are most unusual. During even a common cold, however, a mass of adenoids in the vault serves as a very efficient means of conveying infection to the middle ear. A small percentage of middle-ear cases develop mastoid disease; and a still smaller percentage, sinus thrombosis, with or without jugular involvement. In advising parents the physician should clearly portray the culture field which the child may be maintaining in the upper respiratory tract.

**Operation for Permanent Relief.**—Various methods have been devised, all of which have their enthusiastic adherents, for the removal of enlarged tonsils and adenoids. For a discussion of these methods and their relative merits the reader is referred to works dealing with the surgery of the nose and throat.

Certain facts relating to the conduct of this operation are worthy of emphasis from the standpoint of the pediatricist, of which the following may be mentioned:

Operation is contraindicated, except in urgent cases, during the prevalence of an epidemic of a respiratory disease and whenever the patient shows evidence of bronchitis or extreme throat congestion.

The preparation for the operation should include abstinence from food for a period of at least six hours.

The anesthesia should be as short and as light as possible to satisfy the requirements of the operator. The dangers of chloroform should always be kept in mind, and if it is used extra care on the part of the anesthetist should be exercised. The operation should be as rapid as is consistent with care and thoroughness and should in every instance secure complete enucleation of the tonsil irrespective of the method employed. All hemorrhage should be positively checked before the patient is removed from the table.

Attendance of a nurse for at least six hours following the operation is essential.

Convalescence in bed should be enforced for a period of three to four days. This insures a minimum loss in weight and a more rapid recovery.

**x-Ray Treatment of Tonsils and Adenoids.**—Considerable literature has accumulated relating to the treatment of diseased tonsils and adenoids by means of x-ray. Witherbee, Remer, and others have made careful and painstaking observations of a large series of cases. It would appear that they have established a field of usefulness for this procedure. In cases in which there is gland hyperplasia with infected foci the x-ray has given satisfactory results in sterilizing the infected areas and shrinking the glandular tissue.

In cases with marked connective tissue increase enucleation by surgical procedures will always remain the operative treatment. For cases of diseased infected tonsils in subjects with status lymphaticus, the bleeding diathesis, and in grave cardiac disease it is wise to give x-ray therapy a trial at the hands of those skilled in its use.

**Benefits of the Removal of the Tonsils and Adenoids.**—The usual advantages claimed, those relating to mouth breathing, facial deformities, etc., are sufficiently well known to require no mention. Certain other benefits are perhaps not generally appreciated.

*Effect Upon Delicate Children.*—In office work one has occasion to treat a large number of children who come because of defective growth, who are suffering from secondary anemia, or who are otherwise delicate. Remarkable improvement in these children follows the removal of diseased tonsils and adenoids.

*Influence Upon Acute Infections.*—In grippe, scarlet fever, measles, diphtheria, and other acute infections a considerable source of danger lies in the associated pyogenic infections of the throat and nasopharynx, involving secondarily the ears and the adjacent structures, the glands, and through the blood-stream the kidneys and the heart. The presence of diseased tonsils and adenoids supplies an ideal culture field for pyogenic bacteria and greatly enhances the child's chances for dangerous

complications. For example, it is comparatively rare to find otitis media in the absence of adenoids.

Adenitis in any common form is a relatively unusual occurrence in a child who has had the adenoids and tonsils properly removed.

Notwithstanding the large number of cases operated upon, one never hears regret expressed by the parents because of an operation properly performed.

#### RETROPHARYNGEAL ADENITIS

Retropharyngeal adenitis, as the name implies, is an inflammation of one or more of the glands situated posterior to the pharynx, between the pharyngeal and prevertebral muscles.

**Symptoms.**—Pain and difficulty in swallowing are always present. Other symptoms are fever—100° to 103° F.—and loss of appetite. The patient often holds the head toward the affected side, so as to relax the muscle tension caused by the tumor. If the adenitis is situated low down, disturbance of the voice (cracked voice) and respiratory obstruction may result.

**Diagnosis.**—In an acute case inspection of the throat will usually show a swelling at the right of the median line. If situated low down on the posterior pharyngeal wall, the adenitis may escape detection. Upon digital examination, instead of a smooth, flat surface, the finger encounters an elevated, rounded mass, which should not be mistaken for an unduly prominent cervical vertebra.

**Prognosis.**—The glands, as a rule, suppurate, forming a retropharyngeal abscess. This, however, does not invariably follow.

**Treatment.**—The treatment must be both local and constitutional. Local treatment consists in cleanliness. The mouth should be washed with a saturated solution of boric acid after each feeding. Iodids, in treating adenitis in children, have been found of questionable service. More is accomplished by suitable diet and plenty of fresh air.

#### ACUTE RETROPHARYNGEAL ABSCESS

Acute retropharyngeal abscess is the result of an infection of one or more of the retropharyngeal lymph-nodes which form a chain on either side of the median line, posterior to the pharynx, and between the pharyngeal and the prevertebral muscles.

**Location.**—The abscess is most frequently situated to the right of the median line. It may be located high in the pharynx, so as to be plainly visible when the mouth is well opened, or it may be placed low, posterior to the larynx and upper trachea. Usually the abscess points anteriorly into the throat. It may point both externally and internally. In a large number of cases not one was seen that pointed externally only.

**Age of Patients.**—Retropharyngeal abscess is pre-eminently a disease of infancy. The retropharyngeal lymph-nodes are said to disappear at the third year. We have not seen a case in a child over three years of age.

**Etiology.**—Any active infection of the throat may cause the disease. It may occur without our knowledge of any infectious process having been present. All throats continually harbor pathogenic bacteria,

which may infect the retropharyngeal lymph-nodes. The disease is usually secondary to retropharyngeal adenitis due to infection from adjacent diseased structures.

It has not been our observation that retropharyngeal abscess is a common sequel of diphtheria and the exanthemata.

**Symptoms.**—Morse and others have emphasized the fact that these cases are usually overlooked—erroneously diagnosed. They are frequently diagnosed as cases of adenoids, and the removal operation is advised.

It is a mistake to lay down too definite a symptomatology of a condition that lends itself to widely varying symptoms. In describing the disease writers tell us that the patient holds the head in a characteristic position—backward and toward the affected side—that the breathing is noisy and stertorous in character, that there is difficulty in swallowing, that there are enlarged lymph-glands at the angle of the jaw, that there is usually a high fever, and that a bulging of one side of the posterior pharyngeal wall is usually visible. It is exceedingly rare to find this combination of symptoms. There are two diagnostic symptoms that are present in all cases—difficulty in swallowing and a persistently changed voice—a so-called cracked, high-pitched voice. These symptoms should lead one to suspect retropharyngeal adenitis or abscess, and the finger examination determines which condition is present. If adenitis exists, a rounded, hard tumor will be felt; if an abscess has formed, a soft, fluctuating tumor will be detected. This may be placed so high in the pharyngeal vault as to be plainly seen through a wide-open mouth, or it may be low and out of sight in ordinary examination. There is a variation of at least 2 inches in the possible location of the abscess, and this fact accounts for the varying symptomatology. The difficulty in swallowing interferes greatly with nursing, and should always lead the physician not only to inspection but also to digital examination of the throat.

*Illustrative Cases.*—*Case 1.*—A baby nine months of age had been under treatment in one of the outdoor clinics of New York City. A diagnosis of adenoids had been made and a day appointed for the operation. The mother, wishing to have the diagnosis of adenoids confirmed, brought the child to the Babies' Hospital. The symptoms of mouth-breathing, nasal voice, and slight difficulty in swallowing had been present for a couple of weeks. There was no characteristic position of the head, no rigidity of the neck, no superficial enlargement of the lymphatic glands. Inspection of the throat disclosed a bulging forward of the soft palate on the right side. A digital examination revealed a round, fluctuating mass, the size of a hickory-nut. It was found high on the posterior pharyngeal wall and almost entirely covered by the soft palate. No adenoids were present.

*Case 2.*—A baby two years of age had been ill for a week with tonsillar diphtheria and was thought to be recovering, when suddenly the voice became hoarse and croupy, with gradually increasing dyspnea. Both expiratory and inspiratory obstruction were present, such as we expect in laryngeal diphtheria, and the attending physician, an excellent practitioner, naturally concluded that the diphtheric process had extended to the larynx. There was stiffness of the neck, but no nasal obstruction. (See above.) There was slight difficulty in swallowing. Inspection of the throat with a dim light revealed nothing but the enlarged tonsils. The writer was called to intubate, and finding the respiratory obstruction sufficient to require intubation, proceeded to make a digital examination, as is his custom before intubating. He was not a little surprised to find a soft, fluctuating mass low down in the pharyngeal wall, extending below and pressing against the glottis. The abscess was opened, with immediate relief of the obstruction.

*Case 3.*—A baby, seven and a half months of age, was an inmate of the country branch of the New York Infant Asylum during the senior author's service in that

institution.<sup>1</sup> His attention was first called to the child because of the difficulty in swallowing. There was very little obstruction, but the voice was harsh, hoarse, and croupy. About a month previous there had been a suppurating submaxillary adenitis. On examining the throat, a large abscess was visible on the right pharyngeal wall, extending downward as far as could be seen. This case afforded the author's first experience with retropharyngeal abscess, and a Denhard gag of the O'Dwyer set, which should never be used in these cases, was introduced while the child was held in an upright position by the assistant. While the writer was feeling for the thinnest point of the sac for a suitable place for the incision, the child suddenly stopped breathing, and became limp and apparently lifeless. An intubation tube, the smallest of the O'Dwyer set, was quickly introduced without the gag. After several minutes of artificial respiration, the use of oxygen, and free hypodermic stimulation with brandy, respiration was again established. The first inspiration was so long delayed that we had almost given up the case as hopeless, when the first short gasp occurred. In half an hour the child had sufficiently recovered to allow the opening of the abscess. This was done without a gag, with the tube in position. After a copious discharge of pus the tube was removed and the child recovered. In this case the suffocation was doubtless due to the introduction of the gag and the pressure of the finger, which forced the pus into the lower portion of the sac which extended below the glottis, where the pus exerted sufficient pressure to prevent the entrance of air.

*Case 4.*—A private patient one year old had diphtheria—laryngeal, faucial, and tonsillar. Under 9000 units of antitoxin and intubation satisfactory progress was made, and on the eighth day of the illness the tube was removed. It had to be replaced in a few minutes because of returning dyspnea. Upon replacing the tube an abscess was found in the right posterior pharyngeal wall, pressing upon and extending below the larynx. The presence of the tube had prevented the recognition of the abscess. Upon determination of the cause of the obstruction the abscess was evacuated, but the marked edema of the glottis still caused considerable respiratory obstruction, and the tube was required for two weeks longer. The child made a perfect recovery.

*Case 5.*—Two weeks after the apparent termination of a fever of several days' duration ascribed to otitis a sixteen-month-old girl developed persistent vomiting attacks associated with more fever. Vomiting occurred immediately after the taking of food, whether solid or liquid, was not projectile, and was unaccompanied by signs of digestive incompetency. The vomiting was promptly terminated by the discovery and incision of a retropharyngeal abscess. In this instance dyspnea, hoarseness, the peculiar attitude of the head and neck, and pronounced cervical adenitis were all lacking.

The above cases are cited in detail in order that the reader may the more fully realize that retropharyngeal abscess may exist without the so-called "characteristic symptoms," and also to emphasize the fact that many cases have been, and will continue to be, overlooked until physicians use the finger as an aid to diagnosis of the diseases of the upper respiratory tract. It is to be remembered that there is no "characteristic breathing" and no "characteristic position" of the head with retropharyngeal abscess.

*Fever.*—There is no characteristic temperature: it may vary a degree or two from the normal or it may range high—from 103° to 105° F.

*Treatment.*—There is but one means of treatment—incision and evacuation of the pus. In order that this may be done it is necessary that the child be under perfect control. The arms should be bound to the sides with a large towel or a small sheet, securely pinned. The patient is held in an upright position on the lap of the attendant, who passes his left arm around the child, while his right hand grasps the forehead, drawing the head for further support backward against his right shoulder. The operation should be performed in a good light—either reflected light from a head-mirror or direct light from a window. With a tongue depressor in the operator's left hand holding the tongue out of the way, the mouth is kept open, and the right hand is free to make the incision,

<sup>1</sup> The case was reported at the time by Dr. Henry E. Tuley, assistant resident physician.

for which an ordinary scalpel is used. The proximal portion of the cutting surface should be guarded with adhesive plaster wrapped around the blade. The incision should be made from above downward, at least  $\frac{1}{2}$  inch in length. A basin should be in readiness and the attendant should be instructed to invert the child at a word from the operator as soon as the incision is made. This allows the pus and blood, which, if aspirated into the trachea, may produce fatal results, to stream out of the mouth. While the abscess is discharging and the head is dependent, the clean index-finger of the operator should explore the cavity, enlarge the opening, if necessary, and remove any necrotic tissue that may be present. The case should be carefully watched for several days, as the opening may close before resolution is complete, particularly if it has not been enlarged with the finger. Recovery is usually complete in from five to seven days.

Occasionally the abscess points outward and requires external incision.

#### RETROPHARYNGEAL ABSCESS COMPLICATING TUBERCULOUS CARIES OF THE CERVICAL VERTEBRÆ

This is usually wrongly described as identical with idiopathic retropharyngeal abscess, but actually is a part of, and results from, tuberculous disease of the spine, which will be referred to later (page 795).

#### ACUTE CATARRHAL LARYNGITIS (SPASMODIC CROUP)

In acute catarrhal laryngitis two factors are operative: the local infection, causing a swelling and infiltration of the mucous membrane, and the laryngeal spasm which is apparently excited by the local process.

**Etiology.**—The disease may be primary or secondary to inflammatory conditions in the nasopharynx. Exposure to cold is a predisposing cause. Rachitic children, if they develop the disease, are liable to have it in a severe form. They are no more predisposed, however, than normal children. Adenoids and enlarged tonsils are predisposing causes.

*Illustrative Case.*—A case which demonstrates the possible effects of sudden cold occurred at the New York Infant Asylum. A delicate baby, six months of age, was exposed for a few minutes on a very cold, windy, December day, with no head covering and simple ward clothing. Within an hour a croupy cough had developed, and in three hours intubation was necessary.

**Pathology.**—Early in the attack the mucous membrane is swollen and free from secretion. In older children when a laryngoscopic examination is possible, the mucous membrane is seen to be intensely congested and dry. When resolution begins, the parts appear glistening and edematous. The lesion itself, however, is never sufficient to produce the obstruction to inspiration peculiar to these cases, as the mucosa is probably alone involved.

**Symptoms.**—The onset may be sudden or gradual. Cases of gradual onset usually follow an acute inflammatory condition of the nasopharynx, the fauces and larynx becoming successively involved over a period of perhaps two or three days before the laryngitis is well marked. The temperature at the onset is usually not high. One of the early symptoms indicating laryngeal involvement is a hard, dry cough, croupy and "bark-

ing" in character. The croupy cough increases in severity toward evening, and is often associated with urgent respiratory obstruction.

In a typical case with sudden onset the following are the more frequent symptoms: The child retires at the usual hour in apparently good health; a few hours later he wakes with the characteristic cough, active laryngeal spasm, cyanosis and labored efforts at inspiration involving dilatation of the alae nasi, suprasternal and infrasternal recession, profuse perspiration, and rapid pulse. The expression is anxious and the child cries in fear. The temperature is variable, but usually elevated. Expiration is usually unimpeded. Under right treatment the symptoms of spasm subside and do not recur on the following night. The cough, which persists for a few days, subsides under proper treatment. In some of the cases, however, the course is not so favorable; the cough continues, becoming stridulous, every inspiration being accompanied by a loud crowing sound, and in extreme instances the laryngeal obstruction due to the swelling and laryngeal spasm is so severe as to require intubation. In our experience, however, this is very rare. Only one child with catarrhal, non-membranous croup—the infant already referred to—required intubation.

**Differential Diagnosis.**—Acute laryngitis may be confused with diphtheric or membranous laryngitis. (For differentiation, see p. 697.)

Laryngismus stridulus may be mistaken for catarrhal laryngitis. Differentiation is easy when one remembers that in laryngismus stridulus there is no cough, and that the laryngeal spasm is often associated with excitement or fright in conjunction with enlarged thymus. Furthermore, laryngismus stridulus does not occur as a definite acute illness, but as a reaction to an underlying constitutional defect. The continuous obstruction, always associated with inflammatory conditions of acute catarrhal laryngitis, is, moreover, absent in laryngismus.

Retropharyngeal adenitis or abscess may be confused with catarrhal laryngitis. Respiratory obstruction in acute laryngitis is apparent only during inspiration, and the cough and dyspnea are usually of sudden onset. Retropharyngeal adenitis and abscess are characterized by a persistence of the symptoms while the disease is active. Digital exploration of the pharynx makes the differentiation final. In congenital stridor the stridor is relieved by stress or excitement, the noisy breathing and other evidences of obstruction being worst when the child is quiet or asleep.

**Treatment.**—In the treatment of catarrhal laryngitis in children two conditions must be kept in mind: first, the inflammatory infiltration and dryness of the parts, producing the metallic cough and the stridulous breathing; second, the laryngeal spasm, which is purely a nervous manifestation, doubtless due to irritation of the terminal filaments of the recurrent laryngeal nerves.

By no means every case of laryngitis in a child develops into croup. When croup is present, however, we know that its existence is due to the association of laryngeal spasm with congestion and inflammation. If we are to promote quick recoveries we must not lose sight of the important nervous element.

*Expectorants.*—For the simple coughs, without accompanying in-

terference with respiration, treatment with expectorants and steam is of great service, regardless of the age of the child. This treatment should be preceded by the administration of a full dose—from 1 to 3 teaspoonfuls—of castor oil. To a child under one year of age a tablet composed of tartar emetic,  $\frac{1}{100}$  grain, with powdered ipecac  $\frac{1}{60}$  grain, should be given every two hours—eight doses in the twenty-four hours. If the tablets or powders are not available, 2 drops of syrup of ipecac may be given instead. To a child from one to two years of age a tablet or powder composed of  $\frac{1}{100}$  grain of tartar emetic,  $\frac{1}{40}$



Fig. 61.—Crib prepared for steam inhalation.

grain of powdered ipecac, and  $\frac{1}{4}$  grain of Dover's powder may be given at two-hour intervals—eight doses in twenty-four hours. After the first day the treatment should be resumed early in the morning, so that by evening, when the cough and spasm are most severe, the full influence of the drugs may be secured. From the third to the sixth year a powder or tablet composed of tartar emetic,  $\frac{1}{90}$  grain, powdered ipecac,  $\frac{1}{30}$  grain, and Dover's powder,  $\frac{1}{2}$  grain, should be given at two-hour intervals—eight doses in twenty-four hours. At least eight doses of one of the above prescriptions should be given daily in order to get the full benefit

of the drugs employed. If the Dover's powder produces constipation, this ingredient may be omitted or counteracted by a laxative. Ordinarily treatment need not be continued more than two or three days. In case the attack is mild the Dover's powder should be omitted.

*Cold Compresses.*—In the treatment of older children the application of a cold compress to the throat is a valuable local measure. A napkin or piece of old linen so folded that there are at least six layers of the material, should be moistened with cold water at 60° F., wrung thoroughly, and placed against the neck, under the jaw, so as to extend from ear to ear. Over this should be placed a piece of oiled silk or rubber tissue held in position by a strip of thin muslin or cheese-cloth, which should be brought together at the ends and fastened at the top of the head. The compress should be changed every thirty minutes. In the management of very young children this measure is rarely satisfactory, for the reason that it is difficult to force the child to allow the bandage to remain in place. The practice of placing the compress around the neck, as is often done, is of no value, as the dressing does not even overlies the affected parts.

*Steam inhalations* are effective only when the patient is kept in an inclosed space. Steam diffused throughout the room is of little or no service. The most comfortable and practical place for the child is in his crib, which should be covered with a sheet. An open umbrella may be employed when a crib is not available. Under the umbrella, which rests upon the bed, lies the child, and covering all is a sheet pinned to the umbrella. If preferred, the open umbrella, draped as before, may be placed over the baby carriage. Any apparatus is adequate which will furnish steam and conduct it to the inclosed space. The Holt croup kettle when obtainable is always to be used. The steaming may be continued for hours. The sheet should be removed occasionally for a few moments in order to allow a change of air. Usually a child may be kept under the tent from twenty minutes to one-half hour without such a change. The tent is seldom so close as to prevent all ventilation.

*Calomel Fumigations.*—A quicker and more effectual means than the treatment with steam is the use of calomel fumigations. The patient is placed under a tent prepared as above. Ten grains of calomel are placed in any tin receptacle, which rests or is held over the flame. The Ermold lamp, made especially for this purpose, is recommended, although the ordinary alcohol lamp used for warming milk answers every requirement. An ordinary kerosene lamp has served well in a few instances, the calomel being placed in the cover of a tin can which was held by a pair of pincers over the top of the lamp chimney. Regardless of the method the fumigation must be constantly watched by some competent person, so as to avoid the possibility of igniting the bedclothes. When the fumes begin to fill the tent, the child will cough considerably. If the cough continues for more than a few minutes, a portion of the vapor should be permitted to escape. The calomel will be consumed in from five to ten minutes, depending upon the degree of heat used. After the tent is filled with the vapor, the child may inhale it for about one-half hour. The vapor produces free secretion from the mucous membrane of the parts,

and local depletion, resulting in enlargement of the lumen of the larynx and consequent relief of the symptom. The fumigations may be repeated after an interval of two or three hours. In a non-diphtheric case it is rarely necessary to repeat the inhalations more than two or three times.

*Antispasmodics.*—In the cases of sudden onset, in which the spasmodic element is prominent at the commencement of the attack, as indicated by the high-pitched, crowing inspiration, and in some extreme cases by the struggle for breath, the cyanosis, the stridor, and the infra-sternal recession, the above treatment will not avail. We must combine an emetic with antispasmodic drugs. A full dose of syrup of ipecac—1 to 2 teaspoonfuls—or sufficient to produce emesis—should be given at once. If vomiting does not result in twenty minutes, the ipecac should be repeated. After emesis has taken place, the antispasmodic remedies should be brought into use. Antipyrin and sodium bromid are especially effective at this stage. Antipyrin appears to have a direct sedative action on the nervous mechanism of the larynx. To a child two years of age the following prescription may be given:

R. Antipyrini..... gr. j  
Sodii bromidi..... gr. ij  
Syrupi ipecacuanhæ..... gtt. ii-iii  
Aquæ..... q. s. ad. ʒj  
M. Sig.—One such dose every two hours—eight doses in twenty-four hours.

To a child from three to six years of age may be given:

R. Antipyrini..... gr. ij  
Sodii bromidi..... gr. iv  
Syrupi ipecacuanhæ..... gtt. iij  
Syrupi rhei..... gtt. xv  
Aquæ..... q. s. ad. ʒj  
M. Sig.—One such dose every two hours—eight doses in twenty-four hours.

### TRAUMATIC LARYNGITIS

Traumatic laryngitis, although a very rare condition in children, is occasionally observed. It may be caused by the inhalation of steam or irritating gases or the aspiration of carbolic or other strong acids.

*Illustrative Case.*—Death resulted from the aspiration of pure carbolic acid by a child three years of age who was given a teaspoonful of the acid by a five-year-old sister. As soon as it passed the lips the patient cried and coughed. None of the acid was swallowed, apparently, but sufficient was aspirated into the larynx to produce intense congestion and sufficient edema to require immediate operative measures. The parts sloughed extensively and the child died in two weeks from pneumonia resulting from sepsis.

*Treatment.*—No case of corrosive injury to the mucous membrane, sufficient to produce congestion and edema with a resulting inspiratory obstruction which requires operative relief, should ever be intubated except as a temporary expedient, since the presence of a tube will invariably cause extensive sloughing. If the case is urgent, tracheotomy is the only justifiable operation. In two cases due to irritating gases (sulphur dioxide in one case and steam inhalation in another) the treatment consisted in the use of cold applications to the neck by means of wet compresses at a temperature of 60° F. Both patients recovered.

## LARYNGEAL OBSTRUCTION

Laryngeal obstruction may be either complete or partial, causing entire cessation of, or greatly impeded, respiration. As the calls upon the physician for aid in these cases are attended with great urgency, it is well to bear in mind the conditions which may give rise to, or directly cause, laryngeal obstruction. These are referred to in detail under their respective headings. In order of frequency they occur as follows:

1. Acute Catarrhal Laryngitis (Catarrhal Croup), p. 330.
2. Laryngismus Stridulus, p. 537.
3. Membranous Laryngitis (Laryngeal Diphtheria), p. 696.
4. Retropharyngeal Abscess, p. 327.
5. Foreign Bodies in the Larynx (see below).
6. Traumatic Laryngitis, p. 334.
7. New Growths.

Acute catarrhal laryngitis, membranous laryngitis, laryngismus stridulus, and retropharyngeal abscess are by far the most frequent causes of laryngeal obstruction in children. In children, edema is a very infrequent cause of laryngeal obstruction. When present, it is a complication or sequel of other pathologic states; for example, it may result from an inflammation accompanying a low-placed retropharyngeal abscess, a traumatic laryngitis after the inhalation of irritating gases, or from the aspiration of corrosive fluids or powders. (See Insufflation Pneumonia, page 381.)

*Illustrative Case.*—A patient eighteen months of age, during convalescence from a mastoid operation, developed a cellulitis in the tissue about the wound. The inflammation involved the entire side of the face, the lips, and mucous membrane of the mouth, and eventually extended to the larynx, producing edema, with most urgent symptoms of laryngeal obstruction.

The part played by the thymus gland in causing laryngismus is not at all clear; the subject is discussed on page 473.

## FOREIGN BODIES IN THE LARYNX

Foreign bodies are usually lodged in the larynx by an act of sudden inspiration attended by a quick forward movement of the head, as in coughing or laughing with a foreign body in the mouth or between the teeth. The patient is immediately seized with a violent paroxysm of coughing and suffocation, the severity of which depends upon the size and shape of the foreign body.

**Treatment.**—Inversion of the patient has repeatedly been of no service whatever. The first procedure is to introduce into the mouth the index-finger, with the hope that a portion of the mass may protrude sufficiently to make possible its removal. Should the attempt fail, a laryngeal forceps should be brought into use, its introduction being guided and guarded by the index-finger. When this is not successful tracheotomy should be performed to relieve the child from immediate danger of suffocation, after which further surgical procedures may be considered.

## THE LUNGS

## EXAMINATION OF THE LUNGS

Four methods are commonly employed in lung examination: (1) Inspection. (2) Palpation. (3) Percussion. (4) Auscultation.

**Inspection.**—Inspection of infants and young children is of value in determining the existence and nature of any deformity, as well as the rapidity and character of the respiration. The frequency of respiration varies considerably in children. The younger the child, the more rapid the respiration. The variations in number of respirations per minute are about as follows:

Under one year of age.....	30 to 40
One to three years of age.....	24 to 30
Three to ten years of age.....	20 to 24

The most common deformity is the *rachitic chest*, or so-called pigeon-breast. In association with the rachitic chest, as one of the results of the rachitis, is found the funnel chest, which is characterized by marked depression of the sternum.

*The Depressed or Contracted Chest.*—This condition is a result of pneumonia with pleuritic exudation and subsequent adhesions between the lung and the chest wall. Dilatation of the lung is interfered with; the balance between the intrathoracic and extrathoracic air-pressure is not maintained, and deformity is the outcome. Inspiration is marked by a lack of motion on the part of the diseased side as compared with the normal side.

*The Distended Chest.*—When there is effusion into the pleural cavity, and, rarely, when there is pneumothorax, one side of the chest may be much larger than the other. In thin subjects the marking of the ribs is much less pronounced than normal, the sunken interspace being obliterated by the pressure from within. In the distended chest also there will be observed a marked absence of respiratory movement. A great many cases, however, of pleuritic effusion are seen in which such bulging is not present.

*Asthmatic or Fixed Chest.*—Chests of this type are quite common in children, and are so characteristic that by watching the respiration one may readily make a correct diagnosis of the existing condition. In children normal breathing is of the costal type; that is, there is an outward movement of the ribs in inspiration and a downward and inward movement during expiration. In the emphysematous and those undergoing asthmatic seizures both sides of the chest become inactive and the respiration is largely diaphragmatic.

*Defective Expansion.*—In pneumonia and in pleurisy there is delayed and incomplete expansion of the diseased side. In pneumonia, also, there is unusual rapidity of respiration; and in acute pleurisy, characteristic, guarded, interrupted inspiration. In atelectasis the inspiration is very feeble with little or no expansion. In empyema and pneumothorax there is little or no expansion over the affected area.

**Palpation** in the lung examination of infants and young children is of little value. Fremitus serves only to corroborate what may be

learned by percussion and auscultation, and is not to be relied upon. The absence of fremitus in the case of a thin or average built child usually means the presence of fluid in the pleural cavity, but, in the presence of a thick layer of adipose tissue the sign is of little or no value. The presence of marked fremitus may mean consolidation of the lung. The absence of fremitus is no guarantee that there is no consolidation.

**Percussion.**—The value of percussion depends upon the normal resonance of the chest when tapped with the finger or instrument. What is known as normal resonance is the sound produced by percussion over an air-filled lung. The usefulness of percussion in physical diagnosis depends upon the nature or quality of the note and the sense of resistance imparted by the chest to the percussed finger. When possible, percussion should be practised with the patient in a standing or sitting posture. The child should be quiet, if possible, as crying not only disturbs the listener, but changes the quality of the note as a result of the air taken into the chest and the tension on the chest muscles. Light percussion with the finger is preferred to that obtained by pleximeter. The chief value of percussion in pulmonary diagnosis is in determining the presence of fluid in the chest.

The terms employed for expressing the findings in a given case are *normal resonance*, *hyperresonance*, *dulness*, *tympanitic dulness*, and *flatness*. The possibilities of variations in the resonance within the normal are considerable. The position of the patient, the age, the condition of the patient, whether thin or fat, whether quiet or crying, are all factors which may cause the percussion note to vary. The student should familiarize himself with the normal by percussing the chests of many normal children of different ages.

*Hyperresonance of tympanitic quality* is obtained over a hollow body, as over the stomach, over a distended colon, or a pneumothorax.

*Dulness* is characterized by short, high-pitched sounds, caused by a solid body or fluid within the chest cavity, which interferes with the production of the normal resonant note.

*Flatness* is the extreme degree of dulness, and is best demonstrated by percussing a chest filled with fluid. An important feature in determining dulness and flatness is the sense of resistance offered the percussed finger by the chest wall. In the presence of contained fluid the elasticity and vibration of the chest wall are greatly diminished, a fact readily appreciated by the finger percussed.

**Auscultation** consists in examination of the lung by the ear placed directly against the chest, or assisted indirectly by a stethoscope.

Use of the stethoscope in examining infants and young children is almost a necessity. On account of the smallness of the chest and the comparatively large area covered by the ear during direct auscultation a larger field of sound conduction is covered than is desirable for purposes of accurate diagnosis. The small stethoscope bell is best, for the reason that when applied to the chests of emaciated infants it will fit the surface better than a large bell. If the bell does not accurately fit the chest extraneous sounds render examination impossible. For accurate work with infants the unaided ear—so-called immediate auscultation—is out of the question. With older children, after the third or fourth year,

the ear alone may be employed if the physician is unable to accustom himself to a stethoscope. The physician must accustom himself to correct auscultation with the child crying. This, of course, means forced breathing and a great deal of extraneous noise. To one who is accustomed to lung examination of young infants it matters little whether or not the child cries; in fact, in many instances crying is of distinct advantage, because it brings out the respiratory quality of all portions of the lung. In the examination of older children forced breathing is necessary to transmit the sounds we require for diagnosis.

In auscultation all the diagnostician's attention is required for the work in hand. Concentration of the mind is most necessary. Students are best taught to close their eyes during auscultation for the purpose of excluding all visual objects. All sounds appear louder in the darkness or when the eyes are closed. The position of the examiner is important. He should sit erect or lean slightly forward, but never incline his body more than 45 degrees. When the examiner leans too far, the circulatory changes in his ears make his work unsatisfactory and uncertain. It is essential for the student to familiarize himself with the sound produced in the lung and transmitted to the chest wall in the act of normal and forced breathing. The sounds thus produced are known as those of vesicular breathing.



Fig. 62.—Vesicular breathing.



Fig. 63.—Distant vesicular breathing.



Fig. 64.—Exaggerated vesicular breathing.

*Vesicular breathing* has a range of variations within the normal. As in the matter of the study of percussion sounds, repeated examinations of the chest of normal children of various ages and conditions are absolutely required before the nature of normal breathing and its possible variations will be appreciated. Various terms have been used in a comparative sense to describe vesicular breathing, such as "rustling," "blowing," "swishing," "purring," etc.; these are all misleading and useless because there is no other sound resembling the sound of vesicular breathing which deserves mention in comparison. Different investigators have attempted, by means of various devices, to produce the sounds resembling the respiratory murmur in health and its changes in disease, without success.

The respiratory cycle includes the taking of air into the chest—inspiration; and the forcing of the air out of the chest—expiration. The duration of inspiration in comparison to expiration is in the ratio of five to three. The inspiratory sound is not only longer, but harsher in quality than that of expiration. The respiratory characteristics have been diagrammatically described by Cabot in his excellent work on physical diagnosis. *Cabot's diagrams are here used, but modified to correspond to the respiratory peculiarities of children.*

Inspiration is represented by the upward stroke and expiration by the downward stroke. The length of the upstroke, as compared with that of the downstroke, corresponds to the length of inspiration as compared with that of expiration. The thickness of the upstroke as compared with that of the downstroke represents the intensity of inspiration as compared with that of expiration. The pitch of inspiration as compared with that of expiration is represented by the sharpness of the angle which the upstroke makes with the perpendicular.

In the foregoing, an attempt has been made to describe the various phases of normal respiration. That the two sides of the chest may show considerable variation within the normal, due to changes in the position of the body, the age of the patient, and whether he is at rest or active, as in crying, must be appreciated and learned only by repeated studies of the normal. Only when the student has so practised upon and studied the normal chest is he ready to take up the study of the signs of disease.

*Exaggerated breathing* occurs when a sound lung or portion of a sound lung is called upon to do an extra amount of work. This type of breathing is simply compensatory, and occurs when a considerable portion of lung structure is incapacitated by consolidation, as in pneumonia, or by pressure, as in the event of effusion into the pleural sac.



Fig. 65.—Bronchial breathing of moderate intensity.



Fig. 66.—Distant bronchial breathing.



Fig. 67.—Very loud bronchial breathing.

*Diminished or weakened breathing* exists when both inspiration and expiration are feebler than the normal.

Diminished breathing may be due to fluid in the pleural cavity, to pleuritic plastic exudation covering the lung like a blanket, to partial infiltration of the air-cells, to pneumothorax, to bronchitis because the air is impeded in its passage to the air-cells, and to acute pleurisy which gives rise to much pain and causes a much shorter excursion of the chest walls than normal. In all these conditions inspiration is less deep than normal, and diminished respiratory sounds are the result. In laryngeal spasm and in diphtheric laryngitis the respiratory murmur may likewise be greatly weakened because of the failure of sufficient air to pass the obstruction.

*Bronchial breathing* has been symbolically represented and described by Cabot as follows:

The increased length of the downstroke corresponds to the increased duration of expiration, the greater thickness of both lines corresponds to the greater intensity of both sounds, expiratory and inspiratory, while the sharp pitch of the gable on both sides of the perpendicular corresponds to the high pitch of both sounds. Expiration, it will be noticed, slightly exceeds inspiration, both in intensity and in pitch, but considerably

exceeds it in duration. As compared with those of vesicular breathing, almost all the relations are reversed.

Bronchial breathing is found in conditions in which there is complete infiltration of the pulmonary air-cells, leaving only the bronchi open to the inspired air. The vesicular element in the breathing is, therefore, wanting, and the sound produced by the passage of air through the tubes is alone conveyed to the ear; and the more readily because of the solidity which the consolidated lung presents. Any condition, by causing consolidation of the lung, obliterating the air-spaces, may produce bronchial breathing. Thus bronchial breathing of the most pronounced type may be found over a pleural sac filled with fluid. The lungs solidified by the pneumonia or compressed by fluid (carnified) give rise to bronchial breathing which is readily transmitted by the fluid under compression to the exterior of the chest wall. Bronchial breathing heard all over the chest (front, back, axilla, and apex) almost without exception means that the pleural cavity is filled with fluid. Failure to recognize fluid under marked signs of general bronchial breathing is one of the most frequent errors made in chest diagnosis in children.

*Bronchovesicular Breathing.*—We do not recognize bronchovesicular breathing as a distinct type, but one of the forms of weakened or defective breathing.



Fig. 68.—Emphysematous breathing.

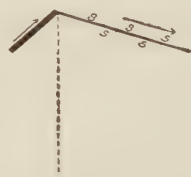


Fig. 69.—Asthmatic breathing: s, s, s, Squeaking (musical) râles.

In *emphysematous breathing* the inspiration is short and somewhat feeble, but not otherwise remarkable. The expiration is long, feeble, and low pitched.

*Asthmatic breathing* differs from emphysematous breathing, the latter being characterized by greater intensity of inspiration. In asthmatic breathing, however, both sounds are usually obscured to a great extent by the presence of piping and squeaking râles.

*Cavernous Breathing.*—Cavernous or amphoric breathing will be found over a cavity in the lung tissue or a large bronchiectasis. The respiratory sound has a peculiar hollow quality both upon inspiration and upon expiration. A low note is produced which has been compared to the sound produced by blowing gently into a wide-mouthed bottle.

*Râles.*—Upon auscultation of the lungs râles of different kinds will be heard. A râle is the sound produced by impeded air in its passage through a bronchus to the lung. This may be brought about through a spasm of the tube, through thickening of its mucous membrane, or the presence of pus, mucus, or water in the bronchial tube. Râles of various types will be produced, depending upon the nature of the lesion

and the size of the tube affected. Thus when there is congestion with infiltration there will be sonorous râles in the large tubes and sibilant râles in the smaller tubes.

*Sonorous râles* are low-pitched snoring sounds, roughened and grating in character. Stridor in laryngitis is akin to the sonorous râles.

*Sibilant râles* are squeaking, hissing, and crackling in character. In the smaller tubes they indicate the same condition as is productive of the sonorous râles in the large tubes, with this difference, that the advent of bronchial spasm is a considerable factor in the production of sibilant râles. Sibilant râles are almost always present in asthma and in asthmatic bronchitis, and may indicate an early stage of bronchitis.

*Mucous or moist râles* are large, medium, and small; and vary in size and number, depending upon the nature of the lesion. They are produced by the passage of air through diseased bronchi containing exudate, and are present in all catarrhal conditions of the lung from whatever cause. In bronchitis and bronchopneumonia, if the examiner is sufficiently industrious, every variety of râle may at some time be heard.

*Crepitant and subcrepitant râles* belong to the subvarieties of moist râles.

## BRONCHITIS

Acute bronchitis, an inflammation of the bronchial mucous membrane, occurs with great frequency in infants and young children.

**Etiology.**—The majority of cases occur during the colder months of the year, when houses are overheated, and when sudden changes in the weather are frequent. The sudden advent of exposure lowers the child's resistance, and the infecting agents which are always present are then given a favorable field for activity.

**Predisposing Causes.**—The chief predisposing cause is absence of resistance to bacterial invasion—a condition peculiar to child life.

Infants and children who are rachitic or who suffer from other forms of malnutrition are particularly susceptible. Chronic rhinitis, enlarged tonsils, and adenoids are predisposing factors of no small consequence.

**Bacteriology.**—The usual bacteriologic agents are the pneumococcus, the influenza bacillus, the staphylococcus, and various types of the streptococcus.

**Types.**—Bronchitis may be divided clinically into three types: primary and secondary acute forms and chronic bronchitis.

**Primary.**—In simple primary bronchitis there may have been an exposure to cold or wet, although this is not at all necessary. The disease is more apt to follow exposure to another individual who has a so-called "cold," and who is, temporarily, at least, a germ carrier.

**Secondary.**—This type is most often found associated with measles, whooping-cough, and grip, or following an acute catarrhal infection of the upper respiratory tract. Secondary bronchitis differs from the acute primary form only in the mode of onset. In the secondary type the onset is gradual—three or more days usually being required before the disease is well advanced.

**Chronic.**—Chronic bronchitis is somewhat rare in the young. It occurs most frequently in conjunction with asthma, or in slow conva-

lescence after bronchopneumonia, and is an accompanying process in chronic pulmonary tuberculosis. Peribronchial thickening occurs in prolonged cases.

**Pathology.**—In simple bronchitis the lesion is very slight. The mucous membrane may show congestion and slight round-cell infiltration, and there may be elevation or loss of superficial epithelium in small areas where the infection is most severe.

**Symptoms.**—The onset of *acute bronchitis* is usually sudden. The cough, which may be extremely troublesome, interferes with sleep, and, in the case of young infants renders the nursing and bottle feeding difficult. The respirations are rarely accelerated above 30 per minute unless there is an associated bronchial spasm. (See p. 347.) There may be moderate prostration; in mild cases there is none. In severe cases the appetite is interfered with. The child is rather peevish and shows general discomfort.

The usual range of the temperature in uncomplicated bronchitis is from 100° to 102° F. When the temperature remains above 102° F., or makes frequent excursions above this point, a complication of some kind will almost always be discoverable to account for the high fever. Frequent causes are intestinal disorder, a developing otitis, or a beginning bronchopneumonia. If the temperature ranges above 102° F. and the respiration is 40 or more, we may be almost certain of a developing pneumonia.

In *chronic bronchitis* the physical signs consist of various types of mucous râles in the bronchi. The medium-sized bronchi are, as a rule, the chief seat of this catarrhal process.

Cough is the most active symptom, and is worse at night. Fever, if present, is due to the associated disease, as chronic bronchitis in a child is rarely an independent illness.

**Physical Signs.**—*Auscultation* of the chest early in an attack will reveal a harsh, roughened respiratory murmur, fairly evenly distributed all over the lungs. Sonorous, sibilant, and mucous râles become audible in from twelve to thirty-six hours.

**Percussion.**—There is no change in the percussion note except in the cases of asthmatic bronchitis (p. 347), which are characterized by hyperresonance or tympanitic dullness.

*Palpation* is here of no aid.

**Duration.**—The duration of an attack of bronchitis depends to some extent upon the child's recuperative powers, but to a much greater degree upon the method of treatment. A primary case properly managed should terminate favorably in a few days. Many cases are not treated at all by a physician. It is these cases of neglected bronchitis which furnish a great majority of our cases of bronchopneumonia, a disease which contributes largely to the mortality of children under five years of age.

**Diagnosis.**—Catarrh of the bronchial tubes, manifested by many râles of different types, is the chief diagnostic feature of simple bronchitis. Cases very often reported as those of capillary bronchitis, in which there is rapid breathing—40 to 60 a minute—high temperature—103° to 105° F.—and marked prostration, show at autopsy the pneumonic elements

which gave during life no other signs in the chest than a diminished respiratory murmur and many fine mucous râles.

**Differential Diagnosis.**—Chronic bronchitis may be differentiated from pulmonary tuberculosis by the temperature range, elevation of the temperature being unusual in chronic bronchitis. The examination of the sputum, the tuberculin skin test, and the x-ray are essential aids to a sure diagnosis.

**Treatment.**—The management of the primary and secondary cases is, in the main, the same, varying, of course, to meet individual conditions or symptoms.

Before indicating what should be done in a case of bronchitis it may be as important, by way of emphasis, to advise what *not* to do. Do not seal the room up tight by keeping all the windows closed. Do not use an oil-silk jacket lined with wadding or any other material. Do not allow the child to be wrapped in blankets and shawls and held against a warm adult body. Do not give the child large doses of so-called "expectorants" in a teaspoonful of a heavy syrup. The temperature of the room should be kept as near 68° F. as possible. There should always be direct communication with the open air. A window lowered an inch or two from the top, or the window-board described on p. 26, is a safe means of assisting in ventilation. The child should be kept in his crib and wear the night clothing to which he was accustomed in health. Many children with bronchitis do not feel particularly ill and rebel against the enforced inactivity. A patient who cannot be kept under the covers may wear a pinning-blanket or a bath-robe while sitting up in bed, but should not be allowed to sleep thus clad.

**The Diet.**—If there is little or no fever the diet need be reduced but little. If there is fever, 100° to 101.5° F., with restlessness and irritability, the food should be reduced in strength, the same amount of fluid being allowed as in health. The diet of a nursing baby can best be reduced by giving a drink of water before each nursing, and shortening the time allowed for nursing from one-third to one-half. We will thus avoid digestive disturbances, which often act as a very serious complication of the existing disorder. Older children, receiving a mixed diet, may be given toast, cocoa, milk, broths, gruels, and fruit juices.

**Steam Inhalations.**—Properly administered medicated steam inhalations are of greater service in bronchitis, particularly in treating young infants, than any other form of treatment which we possess. The steaming is best administered with the child placed in the crib, which is covered and draped with sheets. A croup kettle with alcohol lamp attachment is the most convenient means for generating steam. The nozzle of the croup kettle, which rests on a chair or stand, is carried under the tent at a safe distance from the child's hands and face. For inhalation, creosote has given better results than has any other drug. Ten drops are added to one quart of boiling water and the steaming is continued for thirty minutes.

Ordinarily, in an urgent case, steaming for thirty minutes is given at two-and-a-half-hour intervals day and night until the child recovers. Older children, and those whose condition is not grave, need not receive the steam after the bedtime of mother or nurse. It is well to allow a change

of air in the inclosed space at least three times during the steaming. This is done by raising the sheet for a moment or two and then replacing it. The side of the crib, if preferred, need not be draped.

*Counterirritation* of the skin over the thorax is another very useful method of treatment in bronchitis. Full instructions must be given the mother and nurse as to how the counterirritant is to be applied, or the application will be very indifferently made. In most cases the mustard plaster has been the most convenient means of counterirritation, and has given the best results. It is well to begin with a strength of 1 part of mustard and 2 parts of flour. Two or three applications of this strength may be made. Later, when the skin becomes sensitive, the plaster is to be made weaker by the addition of more flour, 1 part of mustard to 5 or 6 of flour. In order to be effective the plaster should remain in contact with the skin from five to fifteen minutes, until a diffuse blush appears.

The plaster is prepared as follows: Mix the mustard and the flour, using lukewarm water until a paste of medium thickness is formed. This is to be spread on cheese-cloth, old linen, or thin white muslin to a thickness of about  $\frac{1}{8}$  inch. Over this one thickness of cheese-cloth should be placed.

The size of the plaster depends upon the age of the child and the area of lung involved. In a case of general bronchitis the entire thorax, front and back, should be covered. It is easier to make two plasters which meet under the arms than to make one to encircle the thorax, as is sometimes done. A circle is cut out for the arms at the upper corners. If the plasters are sufficiently large to meet at the side, as mentioned above, they may be pinned together. When all is completed, the application really amounts to a mustard jacket.

The plaster may be applied from two to four times daily, depending upon the urgency of the case.

Counterirritation thus made is of great service early in the attack—during the stage of acute congestion. We question whether plasters are of much use after two or three days have elapsed. After removal of the plaster an application of vaselin is grateful to the patient.

*Mustard Baths.*—A mustard bath,  $\frac{1}{2}$  ounce of mustard to 6 gallons of water, at a temperature of 110° F., is of considerable service in the very acute cases in young children, with extensive involvement of the fine tubes, usually known as “capillary bronchitis,” in which there is a great deal of bronchial spasm and considerable shock. The hands and feet are often cold, the respiration is rapid, and the child is considerably prostrated. Under such conditions the bath may be repeated with advantage at intervals of from six to eight hours. The child is to remain in the bath from one to three minutes, during which time the trunk and extremities should be briskly rubbed with the bare hand.

*Drugs.*—The value of drugs in the management of this disease has been considerably overestimated, and they are mentioned last because they are the least important of the remedial agents available.

During the first stage of bronchitis, that of engorgement, indicated by a short, dry cough, and rough, sonorous breathing, small doses of castor oil and syrup of ipecac constitute perhaps our best medication. From the first to the third year 2 to 3 drops of castor oil and 2 to

3 drops of syrup of ipecac may be given every two hours; after the third year, 3 drops of syrup of ipecac and 5 drops of castor oil every two hours. At least eight doses should be given in twenty-four hours. Ordinarily, after twenty-four hours, auscultation will detect more secretion in the bronchi, the fever will diminish, and the child's cough will become loose and less severe. The benefits from the oil and ipecac will be obtained in from forty-two to seventy-two hours, after which this medication should be discontinued.

If the cough and the chest sounds tell us that the bronchi are not yet clear, a combination of tartar emetic, powdered ipecac, and ammonium chlorid may be used. To a child under six months of age a powder or tablet containing 1/150 grain of tartar emetic, 1/80 grain of powdered ipecac, and 1/4 grain of ammonium chlorid should be given at two-hour intervals, eight doses in twenty-four hours; from six months to one year, tartar emetic, 1/100 grain; powdered ipecac, 1/60 grain; ammonium chlorid, 1/4 grain, at two-hour intervals, eight doses in twenty-four hours. If the cough is very annoying and severe, requiring a sedative, 1/4 grain of Dover's powder may be added to each dose for infants under six months, and 1/4 grain for children over six months of age. From one to three years of age, tartar emetic, 1/100 grain; powdered ipecac, 1/40 grain; ammonium chlorid, 1/2 grain, may be given at two-hour intervals, eight doses in twenty-four hours, 1/2 grain of Dover's powder to be added to each dose if the character of the cough demands a sedative. The tablet or powder, whichever is employed, should be given in 2 teaspoonfuls of thin gruel or plain water. After the third year 1/80 grain of tartar emetic, 1/20 grain of pulverized ipecac, and 1 grain of ammonium chlorid may be given every two hours, eight doses in the twenty-four hours. The use of tablets or powders should be insisted upon, particularly in treating very young children. The large doses of ammonium salts and ipecac in heavy syrups are to be avoided because of their liability to produce stomach disturbance.

The treatment of secondary bronchitis depends to a certain extent upon the disease with which it is associated, and the procedure should be modified accordingly. Counterirritation and medicated steam inhalations ordinarily can be used, as they interfere but little with other necessary treatment.

*Treatment of Chronic Cases.*—In chronic bronchitis the removal of enlarged tonsils and adenoids, fresh air, and change to a dry climate, if possible, are our best means of treatment. In addition, general supportive treatment is to be advised as in the management of subnormal children (p. 140). Creasote in small doses, 1 to 3 minims after meals, for a child from two to five years of age, has seemed to be of service to some of these children. The greatest success, however, with these cases has been achieved by ignoring the bronchitis temporarily and putting the child in the best hygienic surroundings. Outdoor life inland and a nutritious diet are far better than drugs. In many of these cases, under such a régime, the disease for which the child was brought for treatment has entirely disappeared without any specific medication whatever, showing that the bronchial catarrh was nothing more nor less than a manifestation of greatly reduced vitality.

## RECURRENT BRONCHITIS

Recurrent bronchitis without the association of asthma and without fever or prostration is occasionally encountered. A typical case of this kind is the following:

*Illustrative Case.*—A plump, well-nourished, four-year-old girl had a history of attacks of bronchitis lasting from five to seven days at intervals of not longer than three weeks. The physical examination was negative. The attacks commenced when she was two years of age and had continued for two years. The temperature was never over 100° F. with the attacks, and the child was not physically ill. She had never had cyclic vomiting, tonsillitis, or rheumatism. (The father was a sufferer from chronic rheumatism.) The patient was given a diet suitable for her age (p. 135), meat being allowed every second day. The considerable quantity of sugar which she had been taking was greatly reduced, only enough being allowed to make the food palatable. She was also given the following prescription:

R.	Sodii salicylatis.....	gr. xxxvj
	Sodii bicarbonatis.....	gr. lxxij
	Elix. simplicis.....	ʒv
	Aquæ.....	q. s. ad. ʒij

M. Sig.—One teaspoonful twice daily after meals.

The above prescription was given for five days, followed by an interval of five days without medicine. This procedure was continued for five months, during which time there was no bronchitis. Later this medication was given ten days each month for one year, with entire relief of the trouble. Withholding sugar and fat from the diet was continued indefinitely. The patient has had no further inconvenience.

When a child develops joint or bone disease, the family can usually recall an injury or fall of some sort to account for the trouble. So, also, in the event of bronchitis, an exposure, a change of clothing, or a change in the weather will usually be regarded as a cause of the attack.

In the case above cited and in many others such factors evidently have had very little, if anything, to do with the bronchitis, for under the same climatic conditions the attacks cease when attention is given to the constitutional condition, and proper diet and medication are prescribed. The patients are usually of gouty or rheumatic ancestry.

**Treatment.**—Sugar and fat cannot be tolerated by patients of this type.

They should lead an active outdoor life when climatic conditions allow. There should always be communication between the sleeping room and the outer air. All possible influencing factors, such as enlarged tonsils and adenoids, are to be removed. (This operation, however, is never sufficient in itself to prevent recurrences.)

**Diet.**—Red meats, including beef, mutton, and lamb, should be given only every second or third day. Sugar is permissible only in sufficient amount to make the food palatable. If the case resists treatment, sugar is to be discontinued and saccharin substituted. Skimmed milk may be given as a drink, 8 ounces being allowed both for breakfast and for supper. Green vegetables and cereals well cooked and suitable for the age may be given freely.

There must be a free evacuation of the bowels daily. If there is a tendency to constipation the management suggested on page 273 is to be applied.

As in a certain group of asthma cases protein sensitization, particularly

to egg, must receive consideration. Occasionally brilliant results follow the elimination from the diet of supposedly harmless food found by cutaneous test to be toxic to the patient. The application of the protein theory has, however, been rather disappointing.

*Medication.*—These patients are not influenced by the usual treatment for bronchitis, so that expectorant drugs may be omitted. Large doses of bicarbonate of soda do more toward shortening the attacks than does any other form of medication. To a child five years of age 10 grains should be given at two-hour intervals.

The interval treatment, with diet, must be relied upon to prevent a recurrence of the attacks. Salicylate of soda is given for five days, in doses of from 3 to 5 grains, well diluted, after meals. The salicylate is then discontinued and the bicarbonate is given for ten days in the same dosage. Next the salicylate is resumed. In this way, by alternating the two drugs or by giving aspirin when the salicylate disagrees, the treatment is continued for two or three months. As the case improves an interval of rest from all medication is instituted. If it is more convenient the salicylate and the bicarbonate of soda may be given at the same time.

*Bathing.*—The skin in these cases should be kept active, and once daily the child should be given a tub-bath in lukewarm water. After the bath a cool spray or spinal douche is to be used, the temperature of the water ranging from 50° to 70° F. An excessive degree of cold is not advisable; it should be sufficient, however, to insure a good reaction after brisk rubbing with a rough towel.

## ACUTE SPASMODIC BRONCHITIS; BRONCHIAL ASTHMA

Infants and young children may suffer from spasmodic attacks of dyspnea—the manifestation of the disease in the adult. With asthma in the child, regardless of age, there is almost invariably an association of bronchitis. In some the nervous phenomenon of spasm predominates with little bronchial involvement. In others there is considerable bronchitis, with slight, moderate, or intense spasm.

In the case of the infant and very young child the term *capillary bronchitis* has been given to two distinct conditions. In one there is an *acute spasmodic bronchitis*, and in the other an *acute infection* of the lungs (pneumonia) without localization. In acute asthmatic bronchitis the mode of onset, the lesions, and the fever are all as found in acute simple bronchitis. The bronchial spasm, however, differentiates the two forms from two standpoints: First, the respiration in the asthmatic type appears very rapid. A rate of 60 is not unusual. The excursions of the chest muscles are, however, incomplete and the rate in many instances is less rapid than it appears. Second, the chest signs are most dissimilar. In the spasmodic cases there may be an entire absence of, or very feeble, respiratory murmur, with inspiration short and squeaking in character, while the expiration is prolonged and accompanied by fine sibilant râles. These signs may exceptionally be localized in one lung or a portion of a lung, more often at the end of the attack, but, as a rule, occur equally in both lungs, the same auscultatory signs occurring over the entire chest. There is but little action of the respiratory muscles, the chest appears

held in fixed position of deep inspiration with little movement of the chest wall, the diaphragm being held contracted and undergoing only short excursions. Both the entrance and exit of air are impeded, but the expiratory act appears the more difficult. Cyanosis, profuse perspiration, and marked prostration are apparent if the attack is prolonged. Percussion elicits hyperresonance or tympanitic dullness.

This type of bronchitis may occur in the youngest infant. Many older children always have the spasmodic condition with bronchitis.

**Etiology.**—Among the many agencies that have been credited with the capacity for causing asthma, but one has been proved positively operative—sensitization to foreign protein. This sensitization may be present at any age.

The asthmatic reaction may be due to sensitization to foods or to inhalation of protein-bearing substances from plants and animals. Infants with eczema frequently have an asthmatic type of bronchitis, and eczema in many infants is due to food anaphylaxis, most frequently to egg, and occasionally to milk. The list of such foods includes also a large variety of vegetables and cereals.

Clinically we may divide asthma into two classes, the sensitive type and the non-sensitive type, according to the following tabulation made by Bell and Larsen.<sup>1</sup>

#### SENSITIVE TYPE

#### NON-SENSITIVE TYPE

##### 1. COURSE OF THE DISEASE

Periodic attacks with complete or nearly complete cessation of pathologic signs between the attacks.

Either chronic cough without dyspnea or periodic remissions with moderate dyspnea, but the pathologic signs tended to remain constant between the remissions.

##### 2. TYPE OF THE ATTACK

Onset in which dyspnea was the most prominent symptom. This was usually characterized by slow, labored breathing with prolongation of the expiratory phase up to the beginning of the inspiratory phase, so that there was no period of rest between. Cough was not prominent at first, but later, after the dyspnea had begun to subside, it became more prominent and lasted after the dyspnea had entirely disappeared. On auscultation in the early stages the râles were similar in all parts of the chest and occurred about equally during all parts of both inspiration and expiration. Toward the end they became looser and were patchy in their distribution, resembling those of simple bronchitis. There was usually acceleration of the pulse-rate, but no rise in temperature.

In those with periodic remissions cough at the onset was the most prominent symptom. Dyspnea, if it appeared, came on from twenty-four to forty-eight hours later and was not as severe as in the sensitive type. It also had a tendency to be more inspiratory in type. On auscultation during the attack the râles were often very similar to those found in the sensitive type, and later also showed a loose quality, but between the attacks these showed a tendency to remain constant, though fewer in number. There was nearly always acceleration of the pulse-rate accompanied by a rise in temperature.

##### 3. DURATION OF THE ATTACK

This varied from a few minutes to a few days and was followed by a relatively rapid convalescence.

This varied from a few days to a week or more and convalescence was relatively slower.

<sup>1</sup> Classification and Management of Asthma in Childhood, Amer. Jour. Dis. Child., November, 1922, vol. 24, pp. 441-449.

## 4. QUALITY OF THE SPUTUM

When obtained this showed a fairly clear gelatinous material with small opaque bodies, Laennec's pearls.

This was slightly more profuse, was thick, yellow or greenish, and purulent.

## 5. BEHAVIOR TOWARD EPINEPHRIN

Intramuscular injections of a solution of epinephrin chlorid 1:1000 gave marked immediate temporary relief.

The relief obtained was not as marked.

In the group of cases classified as non-sensitive are perhaps many in which the activating protein has not been discovered. Some children cough, wheeze, and have restricted asthmatic breathing with every attack of bronchitis; and yet we find that if we prevent them from contracting bronchial infections the asthma does not occur. It is possible, but not established, that in such cases the infecting bacterial organism causing the bronchitis is operative through its protein in causing asthma.

In a group of 44 cases in which sensitivity was determined Bell and Larsen found the reacting proteins gave tests as follows:

Rabbit hair, 32 positive reactions; horse dander, 8; cat hair, 6; dog hair, 1; guinea-pig, 1; feathers, 1; foods, 8; pollens, 3; total, 60 positive reactions.

The importance of rabbit hair in causing asthma was first emphasized by Ratner.<sup>1</sup> This hair is commonly used in the manufacture of felt and may be found in the hats of susceptible children.

In many asthmatic infants and children there is an undoubted gouty (lithemic) diathesis. Not only are such children subject to bronchitis of the spasmodic type, but they also may have attacks of croup, eczema, cyclic vomiting, periodic fever, and periodic intestinal crises, with or without fever, and with or without gastric crises.

Most important dietetic factors in these cases are fat and sugar, particularly cow's milk fat and cane-sugar. These patients during the asthmatic attack develop the acetone breath, but not to the degree that is noted in cyclic vomiting.

*Illustrative Cases.*—*Case 1.*—A girl eight years of age had the history of an attack of asthmatic bronchitis every month for several years. The asthma, although not severe, was present at the onset of the attack, and lasted for perhaps twenty-four hours. The bronchitis usually cleared up in about five days. She had spent but little time in New York because of her so-called frequent "colds," and was brought by her mother for examination in contemplation of a change of residence. In Florida and lower California, where the patient had passed the winter, the attacks had occurred, but were mild in character. As soon as she returned home the attacks returned, keeping her from school for one week out of every four or five. When the matter of adenoids and tonsils was mentioned the mother hastened to state that the adenoids and tonsils had been removed twice, thus demonstrating that they were not a factor in the case. The family history disclosed that all the child's antecedents on both sides, for three generations, had suffered either from rheumatism or gout. The mother had been a life-long sufferer from rheumatism. The child had never suffered from rheumatism or cyclic vomiting. Aside from revealing a mild secondary anemia and slight emphysema, the physical examination proved negative. Upon close questioning, it was found that the patient's diet consisted of red meat twice daily; she disliked vegetables, took cereals only when covered with sugar, and drank milk only when 2 teaspoonfuls of sugar were added to each glass. She had candy and cake *ad libitum*. She was recovering from an attack of bronchitis when examined, and was taking an expectorant cough-syrup.

<sup>1</sup> Ratner, B., Rabbit Hair Asthma in Children, Medical Clinics N. America, 5, 1129, January, 1922.

This was discontinued, red meat was permitted but twice a week, the sugar was largely reduced, saccharin being used in the milk to satisfy the abnormal craving for sweets. She was bribed by the mother to eat green vegetables and cereals. The desserts consisted largely of stewed fruits flavored with saccharin. Candy, cake, and pastry were forbidden. Four grains of the salicylate of soda given three times daily for five days was followed by 10 grains of the bicarbonate three times daily for five days; then for five days there was no medication. This treatment was continued for six months. During the following six months the salicylate and the bicarbonate of soda were given but five days each out of each month. During the entire year but one mild attack of bronchial asthma occurred.

*Case 2.*—A most striking case of periodic asthmatic bronchitis occurred in a boy nine years of age. The father had had inflammatory rheumatism. Of the mother's family, the grandmother was an invalid with rheumatism and the grandfather was slightly rheumatic.

The boy was pale, but well nourished, weighing 68 pounds. He was very active mentally. He had had chickenpox and one attack of tonsillitis. The blood examination showed 78 per cent. of hemoglobin, 5,500,000 red cells, and 8000 leukocytes. The urine was negative. During the previous year he had had a great many attacks of asthmatic bronchitis. The mother stated that they occurred once very three or four weeks. Previous to this time there had been very frequent colds—so many that the boy's attendance at school had been practically nil. The mother had discovered that sugar did not agree with the child, and very little had been given. He was very fond of red meat, however, and wanted it three times a day. It was given twice a day.

A liberal diet of green vegetables, fruits, milk, and cereals was ordered. In addition, egg or bacon was to be given for breakfast, red meat three times a week, poultry three times a week, and fish once a week. Sugar was excluded absolutely, saccharin being used. Aspirin in 3-grain doses was given after each meal, with 5 grains of bicarbonate of soda.

This was the treatment for three months, during which time there was one attack of the asthmatic bronchitis. This responded to ipecac, antipyrin, and sodium bromid. Except for one or two slight colds, the boy experienced no trouble during the ensuing winter and lost but little time at school. At the end of seven months he had gained 7 pounds.

The bicarbonate and aspirin were given continuously for three months. Then for a long period they were given alternately, each for five days, *i. e.*, 3 grains of aspirin three times daily for five days, then 5 grains of bicarbonate of soda twice daily for five days.

In the so-called sensitive type of cases the paroxysm typically occurs preceding the bronchitis as a result of the irritation from plant pollen or the emanations of animals or flowers and often takes the form of hay-fever as well as asthma. Hay-fever and asthma due to pollen allergy are rarely seen in children under five years of age.

For a description of an exceptional case of this type seen by the senior author in consultation we are indebted to the child's physician, Dr. Murray Bass.

Baby W., female, third child, was the daughter of a mother who had suffered from hay-fever for which she had received prophylactic treatment, having exhibited sensitivity to June grass and ragweed.

At the age of six and a half weeks the baby began to show signs of wheezing and mild cough. This grew progressively worse until the child had many attacks of cyanosis and extreme dyspnea. At no time did she run any temperature. Physical examination showed marked asthmatic breathing and sibilant râles over the entire chest. x-Ray of chest failed to show any abnormality. Differential blood count showed an eosinophilia of 23 per cent. Skin tests on the baby showed her to be sensitive to orchard grass, timothy, June grass, redtop and mildly to horse dander.

Treatment consisted in stopping breast feeding, the use of large doses of adrenalin and atropin, and oxygen inhalations. Two treatments of exposure of chest to x-ray were also given with the idea that there was possibly an enlarged thymus, in spite of negative x-ray. After four weeks of severe illness, in several paroxysms of which the child seemed to be moribund, she gradually recovered. "At the present time she is gaining in weight, taking food well, though the chest still shows many râles and the eosinophilia persists."

After several attacks of asthma associated with bronchitis what is sometimes called a true asthma results. Through the direct irritation, dependent on peculiar susceptibility to emanations such as those from cats or horses, or otherwise reflexly because of the presence of abnormalities in the upper respiratory tract, the habit becomes once established and thereafter but very little irritation appears necessary to precipitate an attack. While these seizures may occur without clinical bronchitis, in not one of them will the bronchi be found normal, and the intolerance for carbohydrates is to be considered as in the cases in which clinical bronchitis is in evidence.

As the study of asthma progresses the number of cases classed as sensitive is steadily becoming larger.

**Pathogenesis.**—In the motor nerve supply of the bronchial musculature are constrictor and dilator sets of fibers, and the bronchospasm typical of asthma is induced by irritation of constrictor fibers derived from the vagus. This effect may be induced whenever the mucosa of the upper air passages is irritated by a protein to which the subject is sensitized. In susceptible children the irritant effect may be manifested also by vomiting. In many instances this occurrence is a protective phenomenon to be desired.<sup>1</sup>

It may readily be understood that if the nasal passages are obstructed by adenoids, hypertrophied turbinates, or septal deformity the local susceptibility to irritant substances is correspondingly augmented. During the actual attack the accumulation of tenacious secretion in the bronchi increases the degree of obstruction and only when expectoration is possible is prompt relief obtained. The sputum, when obtainable, is found to be transparent, usually showing "tapioca-like masses" known as Laennec's pearls, together with a high content of eosinophils. Charcot-Leyden crystals, casts, and Curshman's spirals are found more rarely.

While the dyspnea is pronounced at the height of the paroxysm and vital capacity is lessened, systemic effects due to the extreme cyanosis are observable, but, characteristically, as soon as the attack has subsided (provided the asthma is uncomplicated), the lung capacity and alveolar carbon dioxide content are found to be normal.

It is conceivable that endocrinology may in the future contribute to a better understanding of asthmatic phenomena.

**Pathology.**—Peribronchial thickening associated with chronic bronchitis and various grades of tracheobronchial adenopathy comprise the effects induced in subjects of prolonged asthma. Secondary infection with bacteria, particularly various strains of streptococcus adds to the chronicity of many cases. Tuberculosis complicating asthma in childhood, while not rare, is less frequent than one would expect from the contributing factor of bronchitis present in so many asthma cases.

**Treatment.**—The management of a case of asthma in an infant or young child depends upon the nature and severity of the seizures. In a very urgent case 3 to 5 minims of a 1 : 1000 solution of adrenalin may be given hypodermically to a child from two to six years of age. Morphine with atropine may also be necessary in severe cases for the purpose of relieving the patient during the height of a paroxysm. In the cases in which bronchitis is prominent medication by mouth is of much service.

<sup>1</sup>J. C. Walker: Oxford Medicine, II, Chapter VII.

For a child six months of age the following prescription has been found useful:

R.	Syrupi ipecacuanhæ.....	gtt. xviii
	Antipyrinæ.....	gr. vj
	Sodii bromidi.....	gr. xviii
	Syrupi rubi idæi.....	℥v
	Aquæ.....	q. s. ad. ℥ij
M. Sig.	—One teaspoonful every two hours—six doses in twenty-four hours.	

For a child one year of age:

R.	Syrupi ipecacuanhæ.....	gtt. xxiv
	Antipyrinæ.....	gr. xij
	Sodii bromidi.....	gr. xxiv
	Syrupi rubi idæi.....	℥v
	Aquæ.....	q. s. ad. ℥ij
M. Sig.	—One teaspoonful at two-hour intervals—six doses in twenty-four hours.	

For a child from two to three years of age:

R.	Syrupi ipecacuanhæ.....	gtt. xxxvj
	Antipyrinæ.....	gr. xviii
	Sodii bromidi.....	gr. xxxvj
	Syrupi rubi idæi.....	℥v
	Aquæ.....	q. s. ad. ℥ij
M. Sig.	—One teaspoonful in water at two-hour intervals—six doses in twenty-four hours.	

Added relief will be afforded by steam inhalations, as described under Spasmodic Croup (p. 333). If the condition is urgent, the inhalations may be given for thirty-minute periods with thirty-minute rest intervals.

Mustard, in the proportion of 1 part of mustard to 2 parts of flour (p. 846), so applied as to envelop the entire thorax, will often relieve the spasm sufficiently to reduce the respirations from 10 to 20 a minute. The mustard should remain on long enough to redden the skin, and should not be repeated oftener than once in four hours.

The cold-air treatment in bronchial asthma is contraindicated regardless of the age of the patient. Warm, moist air at from 68° to 70° F. is best. A sudden blast of cold air may be sufficient to increase the severity of the paroxysms to a marked degree. Ventilation, however, is a necessity in these cases. The best means of obtaining it is by the use of two rooms, one of which may be aired while the other is occupied. Before the child is changed to the aired room its temperature should be raised to that of the other.

In older children after the fifth year the bronchial spasm may be considerable, and more active measures may be required to furnish temporary relief. Here the methods usually employed for the same purpose in adults may be brought into use. A few whiffs of chloroform will often be effective. Fumes of nitrate of potash paper will sometimes be of service. At this age, also, a combination of antipyrin and bromid of soda may be brought into use. For a child from five to ten years of age 3 grains of antipyrin with 6 to 10 grains of bromid of soda, repeated in two hours, will often obtain a cessation of the paroxysm. As soon as the spasm subsides the sedatives should be discontinued. We have almost

never found it necessary to give morphin hypodermically or otherwise in these cases.

*Illustrative Case.*—In a very severe case, in a girl eight years of age, a combination of antipyrin and codein in full dosage was required to control the paroxysms. She was given  $\frac{1}{4}$  grain of codein and 4 grains of antipyrin at two-hour intervals until three doses had been given.

Before instituting interval treatment all growths and deformities in the rhinopharynx should be removed or corrected and the child given a suitable living régime.

Inasmuch as it is often impossible to differentiate the two types of asthma clinically, it would seem advisable to do the protein skin reactions on all cases in which there is a possibility of existing sensitivity. The great majority of cases will be found to react to one or more of a relatively small number of substances. The following list includes all except the more unusual causes:

*Inhaled Materials.*

Horse dander.  
Rabbit hair.  
Cat hair.  
Dog hair.  
Sheep wool.  
Chicken, duck, and goose feathers.  
Cotton seed.  
Orris root (talcum powder).  
Pyrethrum (insect powder).  
Wind-borne pollens which vary in different localities.

*Ingested Materials.*

Egg-white (ovomucoid).		
Egg-yolk.		
Milk (lactalbumin, casein).		
Wheat (gliadin).		
Barley.	Corn.	Oat.
Cocoanut.	Cocoa.	Beef.
Veal.	Bean.	Beet.
Pea.	Peanut.	Potato.
Crab.	Lobster.	Oyster.
Rhubarb.	Strawberry.	Mustard.
Rice.	Rye.	Almond.
Chicken.	Lamb.	Pork.
Carrot.	Celery.	Lettuce.
Spinach.	Tomato.	Clam.
Banana.	Orange.	Prune.

Cooke<sup>1</sup> has found a large number of patients reacting to the dust found in their home environment.

*Technic of Skin Test.*—In making the cutaneous tests the scratch method devised by Schloss and Walker is to be preferred. An area on the back or chest in a baby, or the flexor surface of the forearm in an older child is cleansed with alcohol, and a scratch  $\frac{1}{8}$  inch long is made with a large Hagedorn needle. On this scratch is placed a drop of hundredth-normal sodium hydroxid and a small amount of the dried extract is dissolved in this drop. In fifteen to twenty minutes the site is gently cleaned with separate twists of cotton and the reading made. A positive reaction varies with the material used. The pollens usually give the largest reaction, the inhalants the next largest, and the ingested substances the smallest. A small reaction may have as much clinical significance as a large one.

In interpreting the results a simple erythema alone or accompanying a small round wheal less than 0.5 cm. in diameter is noted as “±.” Wheals with irregular outline from 0.5 to 1 cm. in diameter as “+,” and for each half centimeter more of diameter a plus mark is added. Doubtful tests must be repeated several times before a definite conclusion is reached.

<sup>1</sup> Studies in Specific Hypersensitiveness, III, Jour. Immunology, March, 1922.

*Interval Treatment.*—For the bottle fed this consists in reduction of the sugar to one-half the amount suitable for the age, and the use of 1 grain of bicarbonate of soda for each ounce of the milk food given. The bowels must be kept properly open, although constipation or intestinal toxemia has seldom appeared to us to be a paramount factor in the asthma of children.

The interval treatment for older children is most important, for by it one may postpone the attacks. Since these cases, as has been indicated, are usual in lithemic subjects, the scheme of management followed out is to some degree the same as for rheumatism, chorea, recurrent bronchitis, and cyclic vomiting. Sugar is reduced to a minimum, and red meat is given not oftener than every second day, and then only in moderate amounts. The child's protein nutrition is maintained by the use of a high protein cereal, such as oatmeal, and purées of dried peas, beans, and lentils. The eating of green vegetables is encouraged. Food between meals is forbidden. Fruits are used in moderation and an active outdoor life is encouraged. At bedtime the child is given a brine bath (p. 843), followed by a vigorous dry rub. The mother or attendant is instructed that one bowel evacuation daily must be insured.

The best method is so to regulate the life of the patient as to avoid contacts with the particular protein or proteins to which the child is proved sensitive. In those cases in which the reaction to one or more proteins is definitely proved, immunization may be attempted by those skilled in this work.

It is good practice in all cases of true asthma or those in which there is a manifest tendency to a bronchitis with associated spasm to advise the removal of all feather pillows, hair mattresses, and sachet and dusting-powders from the environment of the patient, for the reason that such children may be sensitized in a minor degree sufficient to produce a bronchial reaction and show no response to the usual skin tests.

There is no doubt that certain subjects who are "poor oxidizers," with a defective metabolism, the so-called lithemic class, are benefited in a prophylactic way when given a diet containing a meager allowance of fat and sugar. A child overfed on a diet rich in these substances reacts by developing a weakened resistance of the respiratory tract which, in turn, allows a bacterial invasion which we believe to be responsible for much unexplained asthma. Additional help will be supplied these children by the periodic use of bicarbonate of soda in dosage of 10 grains three times daily on alternate weeks.

#### POLLINOSIS, POLLEN DISEASE, HAY-FEVER

Hay-fever in older children is by no means a rare disease. Our youngest patient was three years of age. The disease is due to the influence of plant pollen on the mucous membrane of the nose and throat and represents a pollen protein anaphylaxis. A hay-fever subject may be sensitized to one or half a dozen pollens.

The pollens of ragweed and the grasses are perhaps the pollens most frequently causing hay-fever. Heredity appears to play an important part in the etiology. Oppenheimer and Gottlieb<sup>1</sup> reported that in 90

<sup>1</sup> Medical Record, March 18, 1916.

per cent. of their cases members of the family of the patient suffered with ailments showing manifestations of anaphylaxis.

**Diagnosis.**—The disease may manifest itself any time during the period of the flowering of plants. The first sign is usually that of profuse lacrimation with itching and burning of the eyes. Sneezing and a profuse watery nasal discharge are rarely absent. In many cases later asthmatic seizures develop.

The seizures continue in a given case while the individual is subjected to the action of the pollen to which he is sensitized. The disease may continue during the entire period from May until October.

**The Skin Test.** Individuals who are sensitized to a pollen will usually show a cutaneous reaction to the pollen protein.

The technic of the test has been described on page 353.

Cooke and Vanderveer have mentioned 25 plants which they personally proved had caused hay-fever.

**Treatment.**—Those who desire to treat hay-fever by the use of pollen preparations are advised to consult the publications of Cooke and Vanderveer, Walker, and MacKenzie.

## PNEUMONIA

Pneumonia is an infective process, due to bacterial invasion, seen with the greatest frequency in the young. The influence of cold, which is that of shock, producing a lowered resistance, temporarily makes the individual unusually susceptible to the infecting organisms, which are ever present. On account of the different ways in which these infecting agents manifest themselves in the lungs, two types grossly are produced—*lobar* or *fibrinous pneumonia* and *broncho- or catarrhal pneumonia*.

### LOBAR PNEUMONIA

Lobar pneumonia is an acute infection of the lungs, primary in character, and may occur at any age. Until the second year it occurs less frequently than bronchopneumonia.

**Etiology.**—The influence of cold is to produce a lowered resistance. Exposure may therefore play a part. The disease occurs with greatest frequency during the winter and spring months.

**Bacterial Etiology.**—The specific etiologic cause of lobar pneumonia in a large majority of cases is the pneumococcus (*Diplococcus pneumoniae*, *Micrococcus lanceolatus*) of Fränkel<sup>1</sup> and Weichselbaum.<sup>2</sup> This has been definitely established by a large number of independent workers. In the Rockefeller Institute series of 529 cases the *Diplococcus pneumoniae* was isolated in 454 instances. From the remaining cases were cultured out the Friedländer pneumobacillus, *Bacillus influenzae*, *Streptococcus pyogenes*, *Streptococcus mucosus*, *Staphylococcus aureus*, and mixed growths.

The pneumococcus is an encapsulated, Gram-positive, lancet-shaped diplococcus, which grows fairly easily in artificial media, especially defibrinated blood media, and is characterized by solubility in bile.<sup>3</sup> For

<sup>1</sup> Fränkel, A., *Zeit. f. klin. Med.*, x, 1886.

<sup>2</sup> Weichselbaum, *Med. Jahrbücher*, Wien, 1886.

<sup>3</sup> Neufeld, F., *Zeit. f. Hyg.*, xxxiv, p. 454, 1900.

further morphologic, cultural, and staining characteristics the student is referred to standard text-books on bacteriology.

In 1910 Neufeld, who had previously demonstrated the production of precipitins and agglutinins by the pneumococcus,<sup>1</sup> found that the immune reactions within the pneumococcus group varied.<sup>2</sup> Following out this line, Dochez and Gillespie<sup>3</sup> divided pneumococci into four groups according to their immunologic reactions with homologous sera. Types I, II, and III are the fixed strains showing homologous immune reactions, although Type II shows atypical strains. Type III is the pneumococcus mucosus. Type IV is a heterogeneous group with no definite constant immune reactions. The incidence and mortality of the four groups as reported in the Rockefeller Institute series are as follows:

Type.	Incidence, per cent.	Mortality, per cent.
I.....	33	25
II.....	31	32
III.....	12	45
IV.....	24	16

An efficient therapeutic antipneumococcic serum for Type I is available.<sup>4</sup> Antisera for the other types have not proved effective.

Pneumococci are found in great numbers in the sputum. Pneumococcemia, as reported in various series, can be demonstrated in 10 to over 50 per cent. of the cases. The presence of a pneumococcemia makes the prognosis more grave. Specific immune substances are present in the urine in a large percentage of cases.<sup>5</sup>

*Predisposition.*—Lobar pneumonia in the young is not a disease of the weak. This type of child is the subject of bronchopneumonia. It is just as often the strong, vigorous child who develops lobar pneumonia.

*Pathology.*—The most apparent effects of the disease are those produced in the pulmonary tissue, where there is an exudative inflammation which progresses through four well-recognized stages, to which are applied the terms: (1) *Congestion*; (2) *red hepatization*; (3) *gray hepatization*, and (4) *resolution*. These stages are not always clearly defined; and not infrequently, at postmortem, neighboring portions of a lung simultaneously present the appearances characteristic of two or more stages of the same inflammation. Congestion, consolidation, and resolution have, however, a very constant order of occurrence, and this is well understood when one considers the exudative nature of the inflammatory process.

In the primary stage of *congestion* the involved portion of the lung is the seat of active hyperemia and edema, and becomes darker in color and acquires increased consistence. The alveolar capillaries are turgid, and the epithelial cells lining the air-spaces are swollen. In the stage of *red hepatization* a well-marked exudation into the alveolar spaces ensues. The exudate consists chiefly of fibrin, red blood-cells, leukocytes,

<sup>1</sup> Neufeld, F., *Zeit. f. Hyg.*, xi, 1902.

<sup>2</sup> *Ibid.*, u. Händel, *Arb. k. Gsndhtsamte*, xxxiv, p. 166, 1910.

<sup>3</sup> Dochez and Gillespie, *Jour. Amer. Med. Assoc.*, lxi, p. 72, 1915.

<sup>4</sup> Avery, Chickering, Cole, and Dochez, *Rock. Inst. Monograph No. 7*, 1917.

<sup>5</sup> *Ibid.*

and desquamated epithelial cells. The involved lung structure thus becomes practically solid and roughly resembles liver. The pleurisy, the swelling and heaviness, and the packing of the alveoli are all most marked during the *red* stage. During the stage of *gray hepatization* the alveoli become choked with additional exudate, which consists chiefly of leukocytes, the blood-vessels undergo compression, and the lung mass becomes swollen and heavy, and assumes a gray appearance. The pleura shares in the inflammation and at this period is coated with more or less fibrinous exudate. The stage of *resolution* marks the change by which the air-cells are relieved of their burden and the normal circulation is restored. This process is essentially one of autolysis, involving disinte-

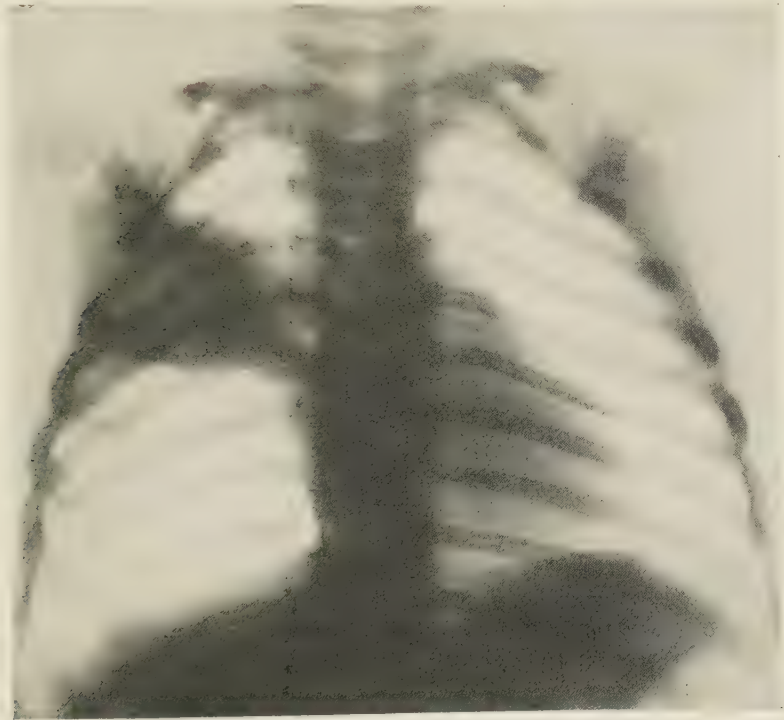


Fig. 70.—Lobar pneumonia of right middle lobe. (Dr. C. H. Perkins.)

gration of the fibrin meshes in the exudate and degeneration of the masses of leukocytes and desquamated epithelial cells. Much of the liquefied exudate is coughed up directly, but more is absorbed and eliminated through the agency of the lymphatics.

Eventually the normal lung structure is restored except in those instances in which the occurrence of interstitial exudate has facilitated the development of abscess or gangrene, or the usual dry pleurisy has been superseded by inflammation of the purulent type—empyema.

In cases of typical lobar pneumonia the pneumococcus present in the circulating blood may give rise to localized abscesses or such fatal complications as peritonitis and meningitis.



by the infection. During the first or the second day of illness the temperature becomes established at a high point— $103^{\circ}$  to  $105^{\circ}$  F.—where it remains, usually with slight variation in a recovery case, until the crisis. This steady high range of temperature (see Fig. 71) is not always followed out, the fever in many cases fluctuating considerably.

*Illustrative Case.*—In an eight months' old child the temperature was that of a typical malaria,  $99^{\circ}$  F. in the morning,  $104^{\circ}$  to  $105^{\circ}$  F. in the late afternoon. The crisis occurred on the eighth day, and the child was promptly well. Thorough examination from every standpoint failed to show other than a lobar pneumonia.

The respiration per minute depends upon the amount of lung involved, the virulence of the infection, and the age of the patient. In children under two years of age, from 60 to 80 respirations per minute are not at all unusual. In older children the respiration is less rapid, often not exceeding 60 per minute. The pulse in young children is in like manner more accelerated—a range from 150 to 180 is not unusual, while in children after the third year the rate may not be above 160.

**Duration of the Attack.**—The duration is variable. In the event of mild infection, probably associated with good resistance, many patients make the crisis on the third day, even before the physical signs are positive. Such cases are by some authors said to represent the abortive type.

In the average recovery case the crisis occurs from the fifth to the ninth day. A crisis delayed beyond the ninth day means a very serious infection and a very grave prognosis. Recovery cases in which the crisis does not occur until the eleventh day are not extremely rare. In one instance the crisis transpired on the thirteenth; and in another on the fifteenth day.

**Unfavorable Symptoms.**—The most unfavorable symptom in lobar pneumonia is a *low temperature* in the presence of the other characteristic signs—rapidity of respiration, rapid pulse, and prostration.

*Illustrative Case.*—The senior author was called by a practitioner in a New York suburb to see a case of pneumonia that disturbed him greatly, although it was impossible to make the parents understand that the child was severely ill. There was no elevation of the temperature—in fact, it was slightly subnormal. The patient, who was ten months old and had been previously healthy, showed marked pallor and prostration not unlike that presented by an acute gastro-intestinal intoxication case, such as is frequently seen in summer. The respiration was about 40 and the pulse was rapid and weak. There was nothing to account for the illness other than a frank consolidation of the right lower lobe. The writer made a fatal prognosis, recognizing the probability of death in a few hours. The child died twelve hours after the visit.

In this case the child was overwhelmed by the pneumococcus infection, so that any reaction indicated by fever was impossible.

Cases of this kind in vigorous children are rare. In athreptics and those older children who suffer from malnutrition or who develop pneumonia after a previous exhausting disease the low temperature range— $100^{\circ}$  to  $102^{\circ}$  F.—is not at all unusual. With it will often be associated petechial skin eruptions. In such instances the prognosis is most unfavorable.

**Tympanites.**—The development of marked abdominal distention is a symptom of grave import, indicating a high grade of toxemia. Further, the distention interferes not a little, mechanically, with the already embarrassed respiration.

*Vomiting* and *diarrhea* are usually occasioned by improper feeding. **Uncorrected**, they add to the dangers of the disease.

*Stupor* and *delirium* are cerebral evidences of the systemic toxemia, and while they indicate a severe infection, their presence is more confusing in a diagnostic sense than an indication of danger to the patient. The symptoms are traditionally more active, particularly the temperature manifestation, when the right apex is involved. Such a localization, however, has no influence on the prognosis.

**Delayed Crisis.**—Every day after the ninth, without the critical drop, adds to the danger to the patient.

Lobar pneumonia is rarely fatal before the ninth day. Deaths, of course, occur earlier, due to the severity of the infection, but this is very exceptional.

Among 6 fatal cases at the New York Infant Asylum in a six months' service, 2 terminated on the eighth day, 2 on the ninth, 2 on the twelfth, and 1 on the twenty-first day of the disease. In the cases of long duration we have to deal with a condition in which the individual is not able to manufacture sufficient antitoxin to destroy the infecting agent or agents, and the question naturally arises, will he be able to do so.

**Complications.**—The advent of a complication adds a more serious aspect to the disease. A complication may appear at any time during an attack, and change what appears to be a favorable case into one of the greatest gravity.

The complications that have occurred under our observation are as follows: myocarditis, pericarditis, pneumococcus meningitis, pneumococcus peritonitis, empyema, peri-arthritis, otitis, pulmonary abscess, and pulmonary gangrene.

**Myocarditis.**—In very severe infections in which the temperature has been high a decided irregularity of the heart action develops. Although no cyanosis or other indication of general heart failure may be apparent, the first sound will be weak and incomplete.

**Pericarditis.**—Fluid, serous or purulent, is more often discovered at the autopsy than recognized during the illness, and is more common in left-sided empyema. Cases have been observed postmortem which showed the pericardial sac filled with pus and fibrin, and the heart surrounded with the exudate so as to be scarcely recognized, although no cardiac sign had been present during life, other than that both sounds were defective.

**Meningitis** of pneumococcus origin (p. 603) is not at all unusual among hospital and asylum patients. An invasion of the meninges by the pneumococcus produces characteristic symptoms (p. 604) quite apart from the usual manifestations of pneumonia, so that recognition of this complication is readily made (Plate I). Further, when the meninges are attacked, the resulting symptoms are very active. At once there may be noted slow, irregular respiration, slow, irregular pulse, stupor from which the child may not be aroused, and change in the pupils.

**Peritonitis.**—Persistent distention of the abdomen, with evident pain on pressure, and obstinate constipation are indications of acute peritonitis. In our experience these cases have all been fatal.

*Empyema* (p. 388) may develop during the pneumonia, in which case the chief manifestation will be a change in the physical signs—the bronchial breathing and bronchial voice changing suddenly to weak, distant bronchial sounds, associated with flatness on percussion.

Empyema, however, is more apt to follow a day or two after the crisis than to occur during the active stage of the disease. It is a complication seen in a large number of cases in different stages of the disease, and the possibility of its development should never be forgotten.

*Peri-arthritis* will be made evident by pain and swelling of a joint, most frequently the shoulder or elbow.

*Otitis* is often overlooked because of the absence of pain to locate the trouble. It often passes unrecognized until a rupture of the drum occurs, the fever being accounted for by the lung disease. Mastoiditis may develop unsuspected.

In every disease of infectious origin the ears should be subjected to a daily otoscopic examination.

#### *Acidosis in Lobar Pneumonia:*

*Illustrative Case.*—A child eighteen months of age developed fever, prostration, and rapid respirations, the typical hyperpnea of acidosis, active deep urgent breathing, in marked contrast to the usual quiet superficial sighing, though rapid, respirations of lobar pneumonia. A heavy trace of acetone was found in the urine and the acetone breath was very noticeable. The chest signs were sufficient for a diagnosis of pneumonia, but the child died from unmistakable acidosis.

**Prognosis.**—This in private cases depends considerably upon whether the patient is under care in a sensible family, or subject to ignorant management. If the physician has the right support the mortality is very low—from 2 to 3 per cent. Among the ignorant and careless it will be higher—from 5 to 10 per cent.—approaching the mortality in hospitals and children's institutions. The high mortality in hospitals is due more to the wretched condition in which the patient arrives than to peculiarly severe features of the disease. In infant asylums and children's institutional homes a lack of resistance to disease is the rule, and pneumonia affords no exception.

**Diagnosis.**—Recognition of the disease in infants and young children is surrounded with few difficulties. The sudden onset of illness, with high fever, rapid respiration, dilatation of the *alæ nasi*, expiratory grunt, and rapid heart action, are objective signs of real significance.

Consolidation of the lungs makes the diagnosis positive. The time of appearance of this sign is, however, subject to considerable variation. It may be present during the first twenty-four hours, but is repeatedly delayed to the fourth day. Rarely consolidation may appear as late as the fifth day. In one case showing very active symptoms otherwise the typical physical signs referable to the lung were not apparent until the seventh day. On the day the consolidation appeared crisis occurred. Cases of this type may go through the entire course of the disease and never show definite consolidation. Such pneumonia was formerly referred to as "central." Mason, of New York, has demonstrated by Roentgen-ray studies that these cases are really those of marginal pneumonia. There is no doubt but that a pneumococcal infection of the lung may exist for several days and run its entire course without the process ever going

on to consolidation demonstrable by our usual means of examination. We know that this is possible in the two- or three-day cases representing clinically the so-called abortive type.

*The Physical Signs.*—As already indicated, auscultation may never reveal a sign of the disease other than harsh or sonorous breathing. As a rule, the infiltration of the air-cells will develop sufficiently from the second to the fourth day to produce bronchial breathing and bronchophony.

Over the consolidated area fine pleuritic friction râles will usually be heard at the height of inspiration when the consolidation makes its appearance. In practically every early case of lobar pneumonia the pleura over the consolidated surface is dry and injected, often showing post-mortem a very fine exudation.

Percussion will show dullness, depending in degree and extent upon the nature and distribution of the lesion. Absolute dullness will be present only over the consolidated area.

The chief value of percussion is in differentiating the presence of fluid from extensive fibrinous exudation, a condition sometimes designated as pleuropneumonia.

Palpation is of little value in examining children, and reveals nothing that may not be learned through auscultation and percussion.

In diagnosing considerable exudations of fluid in the pleural cavity and pneumothorax, the absence of vocal fremitus may furnish corroborative evidence.

The agent to-day of greatest value in detecting and diagnosing pulmonary consolidation is the *x-ray*. This should be employed when possible, particularly in all obscure cases.

**Differential Diagnosis.**—Lobar pneumonia is to be differentiated from bronchopneumonia, from acute pleurisy with massive output of fluid, and from similar cases in which the fluid is less in amount. The differentiation between lobar pneumonia and bronchopneumonia is discussed on p. 373.

*Pleuritic Effusion.*—When there is a fluid, pleuritic exudate sufficient to fill the entire cavity, with the fluid under pressure over a compressed and consolidated lung, signs will be transmitted to the chest wall closely resembling those of frank consolidation. Thus, there may be bronchial breathing and bronchophony of a very intense character over the entire involved side anteriorly and posteriorly, at both the apex and the base. Repeatedly these signs are interpreted by the attending physician as evidence of a complete consolidation of the lung. It is to be remembered that a lung is almost never entirely consolidated in acute pneumonia. Furthermore, in the presence of a massive fluid exudate percussion will elicit flatness over the entire region. When the process is located on the left side, the heart displacement to the right indicates the presence of fluid in the left pleural cavity.

In cases of effusion, finally, there is an absence of friction-sounds and likewise of râles. When doubt exists, as is sometimes the case even after the use of the *x-ray*, which does not invariably differentiate fluid from consolidation, exploratory puncture should always be made. Fluid in lesser amounts is indicated by diminished respiratory sounds, localized flatness, the absence of mucous or pleuritic râles, and displacement of

the heart if the exudation is in sufficient amount. Only in cases in which the pleural cavity is absolutely filled with fluid do we find the voice and respiratory signs of frank lobar pneumonia.

Blood-findings in lobar pneumonia are of special diagnostic significance (see p. 433.)

**Treatment.**—Our efforts in restoring the patient to health are supportive only.

When a child is stricken with lobar pneumonia, our first effort should be to place him in such a position that he may to the best advantage cope with the enemy. In order to do this every detail of his daily life should so be arranged as to assist all the organs of the body most favorably to combat the changed conditions produced by disease. Telling the mother what to do for the fever and writing a prescription for a cough mixture is a most careless method, worthy of the prescribing apothecary rather than a physician. A proper régime must be established as soon as the child becomes ill. The bowel function, the room temperature, ventilation, and sleep, as well as special medication, are all to be considered. The child's comfort demands the avoidance of everything causing restlessness or irritability.

*Open Air.*—For strong robust children the cold-air treatment is to be advised. These patients unquestionably do better with the windows wide open day and night. In such an atmosphere the respiration is slower, the heart action is stronger, and the patients are much more comfortable, sleep better, and make a more satisfactory convalescence. A woolen hood and suitable woolen clothing should be worn.

*The Sick-room.*—When the open-air treatment is not practicable, the temperature of the room should be kept at 61° to 65° F. both day and night, wide fluctuations in the temperature being prevented. A large room, if at hand, should always be selected, and there must always be direct communication with the open air by an open window. The child should be kept in the crib, and not held on the lap of the mother or nurse. Quiet should be maintained in the sick-room, only those in attendance upon the patient being admitted. The presence of curious visitors annoys the child and takes away a certain number of strength units, which may determine the outcome of the case. The advantages of the cold-room or roof treatment in this respect are obvious.

*The Clothing.*—This should be the usual night-clothing. We have long since discarded the oiled-silk jacket or any special form of covering. Such applications are very easy to put on, but very difficult to take off with safety; further, they tend to elevate the temperature of the patient, make him uncomfortable, particularly during convalescence, and prevent the free action of the skin.

*The Bowels.*—There should be a standing order for an enema to be given if the bowels do not move once in twenty-four hours;  $\frac{1}{2}$  to 1 grain of calomel in doses of  $\frac{1}{6}$  grain every hour is usually of considerable service. In a case in which there is very high fever this dosage may be repeated every three or four days.

*Counterirritation.*—Early in the attack, when there is pain, a mustard plaster—one-third mustard and two-thirds flour—mixed to a paste, spread on cheese-cloth, and placed over the involved area for a few mo-

ments, will give signal relief and may be repeated at intervals of from four to five hours. This form of counterirritation is also useful in the convalescence of delicate children when the lung clears slowly, and examination reveals feeble breathing and many mucous râles. In such cases two or three applications daily until the lung clears will suffice. Each application should be maintained until the skin is well reddened, and if this does not occur within ten minutes, the mixture of mustard and flour should be made stronger, one part mustard to one part flour. In a few cases of delayed resolution dry cups daily, applied directly over the involved areas, have been of much service.

*The Diet.*—(See Diet in Illness, p. 154.)

*Management of Pyrexia.*—Whether or not antipyretic measures are to be used, and the nature of the antipyretic to be advised, depends upon the case and the family possibilities relating to care and nursing. One child will bear a temperature without inconvenience which would seriously compromise the chances of recovery of another, so that the thermometer is not a sufficient guide unless the effect of the fever upon the patient be considered. Some children will be delirious and restless and will need antipyretic treatment when the fever is at 103° F., yet a temperature of 104° F. rarely calls for interference. A rise of 1° F. usually means an increase of 20 to 30 heart-beats per minute. We prefer, therefore, that the temperature should not go above 105° F., even if at the time the child shows but little inconvenience.

Cold water, intelligently applied, is the best means of reducing fever. The water may be used either in the form of a sponge-bath or a cool pack. The sponge-bath (p. 840), repeated at intervals of from two to four hours, suffices in a few cases in which the temperature is readily influenced. As a rule the cool pack (p. 841) will be required, especially if the fever is particularly high. The sponge-bath, while not controlling the fever as well as does the pack, possesses the advantage of safety even when administered by the most ignorant. The procedure really amounts to nothing more than sponging the entire body with cool water or alcohol and water. The cool pack requires a trained nurse or an intelligent mother, either of whom should be instructed by the physician as to its use. When cool water is properly applied, and the packs or baths agree, the child, previously restless and perhaps delirious, falls into a quiet sleep; the temperature falls two or three degrees, the pulse becomes slower and fuller, and the respiration less frequent. We have never seen a carefully given pack or bath do harm. In fact, the water is so grateful to the patients that, when old enough, they often ask to have the towel made cooler when it becomes warm and dry from the heat of the body.

*Management of Tympanites.*—Persistent abdominal distention even without peritonitis is one of the danger signs in pneumonia and signifies an extreme degree of toxemia. Measures to combat the condition should be adopted early in the case and procedure found effective should not be relaxed. The less serious degrees of distention are relieved by the use of stupes applied to the abdomen while a rectal tube is kept in the bowel to allow escape of flatus. The coincident administration of spiritus ætheris compositus in doses of 5 to 10 minims given hourly by mouth may also be of service. Daily hot saline colon irrigations or continuous enteroclysis

by the Murphy method should be employed not only for the beneficial effect on distention, but to promote absorption of fluid if little is being taken by mouth.

For extreme degrees of distention with almost complete enteroparesis, physostigmin or pituitrin hypodermically are indicated. The latter is probably safer and in our experience has proved more effective. The dose of pituitrin for a child at least three years old ranges from 3 to 5 minims. This dose may be repeated after an hour if necessary.

*Heart Stimulants.*—A child must never be given a heart stimulant simply because he has pneumonia. Only when the pulse shows signs of weakness, great rapidity, irregularity, or reduced volume has the time arrived for stimulation. For a very rapid pulse, over 150, digitalis is the best stimulant. For a child from six months to one year old, 1 drop of the tincture may be given every two hours—at least six doses in twenty-four hours; for a child from one to three years old, 1 or 2 drops at intervals of two hours—at least six doses in twenty-four hours; for a child of three years or over, 2 or 3 drops at intervals of two hours—at least six doses in twenty-four hours. If the case is a very serious one, the digitalis may be given every two hours during the entire twenty-four, although if the conditions permit it is better to disturb the patient as infrequently as possible during the night. If digitalis disturbs the stomach, strophanthus may be employed.

When the pulse is irregular and intermittent, with reduced volume, strychnin is justifiable. To a child from six months to a year old  $1/300$  grain is to be given every three hours—six doses in twenty-four hours; from the first to the second year,  $1/200$  grain at three-hour intervals—six doses in twenty-four hours; after the second year,  $1/150$  grain may be given at intervals of three or four hours—six doses in twenty-four hours. Children who are under strychnin medication should be carefully watched for signs of the physiologic effects of the drug, the first symptoms being an unusual susceptibility to sudden noise and a slight fibrillary twitching of the muscles of the face and the backs of the hands. Instructions should be given, when these symptoms appear, to discontinue the drug until the next visit of the physician. We have repeatedly noticed these signs of the physiologic effects of the administration of strychnin, and they need cause no anxiety. They are actually necessary in order to get the full benefit of the drug. However, it is only in the most severe cases that this drug should be pushed to such an extent.

When the circulation of the skin is deficient, involving coldness of the extremities and cyanosis, indicated by blueness of the finger-nails and lips, nitroglycerin is indicated. To a child under one year of age,  $1/300$  grain may be given at intervals of two or three hours—six doses in twenty-four hours; to a child from one to three years of age,  $1/200$  grain at three-hour intervals—six doses in twenty-four hours; after the third year,  $1/150$  grain at intervals of two or three hours—six doses in twenty-four hours. Nitroglycerin, if given in large doses, produces headache, of which older children will complain, while nurslings will show their discomfort by restlessness and crying.

Caffein sodiosalicylate is also very useful in cases of this nature, and may with advantage be employed with the strychnin. The dos-

age for a child from six months to one year is  $\frac{1}{2}$  grain. Camphor in the form of the oil of camphor is useful hypodermically in the condition just described. It may be given in 1- to 2-grain doses and repeated in one to two hours. In collapse, 1 : 1000 solution of adrenalin hypodermically, administered in dosage of from 3 to 5 drops, is of much use.

The ammonium preparations are not employed, because their administration even for a short period invariably interferes with nutrition by diminishing the digestive capacity.

Alcohol is often prescribed too early. Most cases of pneumonia pass through an entire attack without one drop of alcohol. This drug in any form should be avoided early in the disease. Later, when the case is doing badly, when the strychnin and digitalis, alone or in combination, fail, the alcohol may be given, and then it may be a life-saving means. It is indicated at this time because it sustains the patient, and at the same time stimulates the heart when regular food assimilation is impossible. To a child under one year of age one may give from 8 to 30 drops of brandy at two-hour intervals; from one to two years of age, 15 drops to 1 dram at two-hour intervals; over two years, 1 to 2 drams at two-hour intervals. Patients who show profound sepsis will require and consume an enormous quantity of alcohol without showing the slightest intoxicating effect.

*Illustrative Case.*—During the senior author's term as resident physician of the New York Infant Asylum a child fourteen months of age, ill with diphtheria, was given 4 ounces of brandy in twenty-four hours without showing signs of stupor or intoxication.

*Hypodermic Stimulation.*—The use of the hypodermic stimulation suggested is to be advised in an emergency, or when the stomach becomes intolerant, or when it becomes evident that drugs administered by mouth are not absorbed. If the dietetic suggestions are carried out, and if disturbing drugs, such as the ammonium salts, heavy syrups, etc., are omitted, there will rarely be any occasion to resort to hypodermic stimulation. When indicated, the doses suggested for the stomach may be given hypodermically, with the exception that alcohol should not thus be given in quantities greater than  $\frac{1}{2}$  dram of brandy or whisky at one time.

Atropin sulphate in dosage ranging from 1/500 to 1/200 grain may be given with good effect when the breathing indicates the beginning of pulmonary edema. This dose may be repeated after three hours.

*Oxygen* exceptionally is of value (see p. 378).

*Gavage.*—Cases are encountered in which, for a time, on account of the profound toxemia, no food or medicine will be taken. In such instances the giving of stimulants and predigested food by means of gavage (p. 853) will be of material assistance. The milk used should be completely peptonized, and to it whisky, brandy, and stimulating drugs may be added. The forced feeding should not be used oftener than once in four hours, and preferably only once in six hours. When thus given the individual doses of the stimulants should be increased.

The *Murphy drip* method of using normal salt solution is of service in cases in which feeding difficulties are insurmountable.

*Specific Medication.*—There is no drug known which will cut short or abort an attack of lobar pneumonia. Mercury in the form of large

doses of calomel, quinin, salicylate of soda, and other drugs have no specific action.

Conservation of the strength of the patient, combined with careful medication to meet special requirements as they arise, constitutes our treatment of lobar pneumonia, and has given a death-rate of only 2 per cent. in children under two years of age. During convalescence great care is needed in permitting the child to resume his usual habits of life, for in the matters of both food and exercise we must make haste slowly.

*Transfusion.*—In long-standing cases of pneumonia in which the vitality of the patient is at an extremely low ebb and assimilative capacity is weak an opportune transfusion may determine recovery. The value of the procedure is probably greater than is generally appreciated. The new blood no doubt has both a nutritive and an immunizing value.

*Illustrative Case.*—A boy six years of age was gravely ill with lobar pneumonia of very severe type. When seen in consultation on the ninth day of the disease, he had been comatose for three days to such a degree that the giving of nourishment was difficult. The temperature continued to range from 105° to 106° F. without sign of impending crisis. Prostration was extreme. Under very free stimulation the heart was showing failure of response. Transfusion was suggested and carried out, 6 ounces of blood being given. In the few hours following the boy showed a better general reaction and on the next day crisis occurred, the temperature dropping to normal. Recovery was uninterrupted. It is, of course, impossible to say that the temperature would not have fallen without the transfusion. Similar experiences, however, in extreme conditions make us feel that this measure was of distinct service and that in transfusion we have a remedy that may carry the patient over the critical period when nature is doing her best without the outcome desired.

*Serum Treatment.*—The serum treatment in small children is relatively unimportant because of the low incidence of fixed types of pneumococcus and the fact that most children withstand a Type 1 infection perfectly well. The serum heretofore employed is effective only in Type I pneumonia and, inasmuch as the prognosis in lobar pneumonia in small children is usually good anyway, there are usually no indications for employment of serum. In the occasional severe Type I infection its use is justified.

The possibility of successfully treating pneumonia in childhood with pneumococcus antibody solution, which was first prepared by Huntoon in 1919, is of great significance. The method has already given encouraging results in a considerable series of adult cases under the supervision of Cecil and Larsen,<sup>1</sup> and Cecil and Baldwin.

An aqueous extract of active immune substance from antipneumococcus serum is employed. This extract is apparently as potent as the ordinary antipneumococcus serum and possesses the distinct advantage of being practically free from the proteins of horse-serum. By reason of its polyvalent character antibody solution contains protective substances against Types I, II, and III of pneumococcus. Moreover, apparently good effects have attended its use in many of the Type IV cases which constitute the predominant group in childhood.

The Felton serum represents a still more highly adapted protective antibody preparation and gives promise of greatest efficacy both in prevention and cure of pneumonia.

<sup>1</sup> Jour. Amer. Med. Assoc., July 29, 1922, vol. lxxix, pp. 343-348.

## BRONCHOPNEUMONIA (CATARRHAL PNEUMONIA)

Bronchopneumonia is preëminently a disease of infancy. On account of its large mortality, and because of its frequent occurrence as a complication of almost every other disease of infancy, it is one of the most formidable ailments which we are called upon to treat. The disease is usually described as primary or secondary. The condition, when described as primary, usually follows a bronchitis—often a neglected bronchitis—and therefore is properly to be termed a secondary condition. The severity of the disease varies considerably, depending on the age and condition of the child, the nature of the infection, and the amount of lung involved. It is most fatal when associated with diphtheria, measles, and pertussis.

Catarrhal pneumonia demands our most careful attention not only on account of the delicate organs attacked, but because, unlike lobar pneumonia, scarlet fever, typhoid fever, and many other diseases of early life, this disease has no self-limitation, no cycle. While in treating the other diseases mentioned we are required only to assist a patient through the various stages, in case of catarrhal pneumonia we must do more, for here a cure is demanded and we are not aided by a tendency to spontaneous limitation.

**Etiology.**—A great majority of the cases occur in children under two years of age. Over one-half of these patients are under one year of age. After the third year bronchopneumonia is unusual except as a complication of measles or pertussis. A chief cause predisposing to bronchopneumonia is, thus, the tender age of the patient, who, on this account, offers little resistance to the infection. Children debilitated from any cause are predisposed for a like reason.

Whooping-cough and measles more than any other diseases predispose to bronchopneumonia. In a large number of fatal cases of marasmus and malnutrition, bronchopneumonia is the terminating illness.

**Bacteriologic Etiology.**—The bacteriologic cause of bronchopneumonia is not a specific entity. There are a number of micro-organisms which may cause the disease, and in over 60 per cent. of the cases there is a mixed infection. This is true even in the primary cases. The *Diplococcus pneumoniae* (Fränkel) is the organism most frequently present, but it is found in pure culture only about one-fourth as often as in combination with other organisms. In children less than three years of age Wollstein<sup>1</sup> found the incidence of fixed types of pneumococcus much less than in adults, whereas Type IV occurred far more frequently. Fortunately, Type III is very rare. The mortality figures for the types approximate the figures for adults. The streptococcus comes next in order of frequency—three times more often in combination than in pure culture. *Staphylococcus aureus* may be present alone, but is far oftener found with the pneumococcus or the streptococcus. The bacillus of Friedländer, either in pure culture or in mixed infection, is a rare cause of bronchopneumonia in children.

Since bronchopneumonia may be secondary to a variety of diseases, the causative organism of the primary condition in a given case may be

<sup>1</sup> New York State Journal of Medicine, vol. 23, No. 4, 1923.

found in the pulmonary lesion. Thus *Bacillus diphtheriæ*, *B. influenzae*, the Bordet-Gengou bacillus of pertussis, *B. typhosus*, *B. pestis*, *B. anthracis*, *B. pyocyaneus*, or the meningococcus may be found associated with one or more of the pyogenic cocci. *Bacillus coli communis* is a possible though very rare factor in this disease.

**Pathology.** Ordinarily the process begins as an inflammation of the terminal bronchioles, "capillary bronchitis," and by extension involves the air-vesicles and takes on the character of a true pneumonia. Bronchopneumonia is, as a rule, bilateral, and only exceptionally involves a single lobe of one lung. The disease usually produces inflammation of the pleura. The affected lung acquires increased weight and the regions most involved acquire a firmer consistence and a deeper red or a grayer color than normal, depending on the stage of the inflammation, which at the outset occasions intense congestion without much leukocytic exudation. On section, the affected portions typically appear mottled, owing to the contrast apparent between the masses of solid and aerated lobules.

Microscopic examination reveals an inflammation of the bronchioles and of the walls of the air-vesicles immediately surrounding. There is not only an exudate in the air-vesicles but also an interstitial exudate. In the bronchopneumonic exudate the cells are more predominantly mononuclear, and the amount of fibrin is less than in the exudate of lobar pneumonia. The lesions are distributed throughout the lungs in patches, but show a tendency to become conglomerate as the disease advances. When the inflammation subsides the exudate is removed, as at the termination of lobar pneumonia by mechanical processes and by the agency of autolysis. The interstitial infiltration characteristic of bronchopneumonia is responsible for the occurrence of its more important sequelæ, none of which commonly follow lobar pneumonia. These are chronic bronchitis, spasmodic asthma, emphysema, and chronic interstitial pneumonia. Pleurisy, when it occurs in children, irrespective of the character of complicating pneumonia, is of a productive type.

**Physical Signs.**—*Auscultation.*—The signs elicited by auscultation depend upon the stage of the disease and the degree of lung involvement.

The respiratory murmur may be weakened over certain areas, or it may be scarcely discernible. Usually an involved area will be found to shade off gradually to the normal. There may be several of these areas.

Areas of localized fine mucous râles are very suggestive of bronchopneumonia. The fine crepitant râle is often heard over the consolidated area. In cases in which there is a considerable distribution of the pneumonic process there will be a wide distribution of râles, with sibilant and fine, moist, mucous râles predominating. The râles are only evenly distributed in cases of the acute congestive type. In these cases they are heard both on inspiration and on expiration, and are of a very fine, crepitant quality.

*Percussion.*—In the very acute cases in which the engorgement interferes with the entrance of air into the lungs extra resonance or tympanitic dulness may be found. In other cases the percussion-note serves as an indication of the degree and extent of lung involvement. The signs vary from normal to those of complete dulness.

*Palpation.*—Whatever may be elicited by palpation is better demonstrated by auscultation and percussion.

*Symptoms.*—The symptoms are most variable, depending upon the age of the patient, the severity of the infection, the extent of lung involved, and the associated illness and complications.

In nearly all cases in which the process in the lungs is active there are three symptoms which rarely fail to be present: accelerated respiration, fever, and cough. The symptoms are only exceptionally urgent at the onset. Usually there is bronchitis for a few days, without high fever or rapidity of the respiration. Then, apparently on the eve of improvement, the temperature ranges higher, the respirations per minute increase, and the child shows prostration.



Fig. 72.—Bilateral bronchopneumonia involving chiefly the lower right lung. (Children's Medical Division, Bellevue Hospital.)

Examination of the lungs at this time may reveal localized fine râles, usually posteriorly in one or both lungs. As the urgency of the symptoms increases the temperature ranges from  $101^{\circ}$  to  $104^{\circ}$  F., subject to considerable variations, and in the event of recovery reaches the normal by lysis.

The respiration rate is from 40 to 60. The pulse-rate is rarely under 140. The usual range is from 140 to 160. Upon the appearance of acute symptoms the chest signs become more marked. Localized areas of fine râles appear in different portions. There are also areas in which the respiratory murmur is very weak. Consolidation usually develops sufficiently to produce bronchophony and bronchial breathing.

*Duration.*—The duration of a case of this type terminating in recovery is rarely less than three weeks. Often a much longer time elapses before the chest will be free. In the fatal cases there is an increase in the volume

of lung involved, shown by the physical signs. The heart action becomes feeble, and death takes place from exhaustion or supervening complication.

**Special Types of Bronchopneumonia.**—In the description of a disease with as wide possibilities as bronchopneumonia a large number of types could be enumerated which would add confusion to the subject. As in most diseases due to infections, death may take place very early or the infection may be so mild as to pass unrecognized. When we take into consideration the age of the patient, the varieties of micro-organisms that may be operative, and the amount of lung tissue that may be involved, we can readily appreciate the occurrence of many and varied manifestations. Among these possibilities there is one feature that should be emphasized. Consolidation of the lung is not necessary for a correct diagnosis of pneumonia. Elevation of the temperature, respiration over

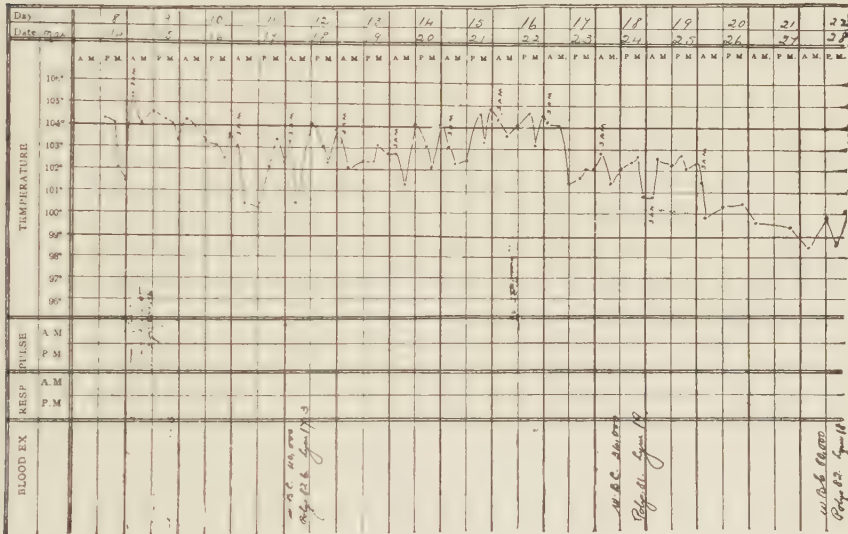


Fig. 73.—Temperature chart. Bronchopneumonia.

40, dilatation of the alæ nasi, and cough, together with mucous râles, usually definitely localized, are sufficient for a positive diagnosis.

*Cases of the More Active Type.*—Bronchopneumonia may be so severe as to be fatal in a few hours.

At the New York Infant Asylum several such cases were observed, which later came to autopsy.

The condition is usually diagnosed as acute capillary bronchitis. In such patients the onset is sudden, with high fever, 103° to 106° F., rapid, labored respiration, 60 to 80, rapid pulse, 160 to 180, and cyanosis. There is immediately marked prostration. The child is toxic and rapidly becomes unconscious. Auscultation detects a very marked increase in respiratory murmur, and a few fine râles. The evidence indicates a sudden invasion of pneumococci of a virulent type.

Doubtless cases of this type are never correctly diagnosed. In two notable instances a positive diagnosis could not have been made but for the autopsy. On account of the urgency of the symptoms and the cerebral manifestations of stupor and sometimes convulsions, the cases are looked upon as those of cerebrospinal meningitis, malignant scarlet fever, suppressed measles, or acute toxemia of intestinal origin.

Postmortem examination shows an intense pulmonary congestion. A free incision in the lung removed immediately after death will be followed by a profuse outflow of dark blood. Excepting the congestion and the presence of the pneumococcus, there are few findings to indicate the nature of the disease, the process having been too active and too rapidly fatal for the development of the lesions.

*Illustrative Case.*—Several years ago the writer was called to perform an autopsy on a six-year-old boy who had died after a two days' illness, the nature of which could not be agreed upon by the medical attendants, none of whom had suspected pneumonia. The autopsy findings were those of an acute pneumonia with intense pulmonary engorgement and with right heart dilatation, which corresponded to the clinical history.

Cases of this nature represent the extreme possibilities of pneumococcus infection.

There are other cases in which the symptoms are urgent, but less pronounced. The onset is sudden, with high fever, 103° to 105° F. The respiration is rapid, 40 to 60. Rarely there is a convulsion. Vomiting is usually present as an early symptom and occurs but once. Except in the nature of the onset, the course in these cases does not vary materially from the usual type first described. The temperature range, physical signs, duration, and prognosis are much the same as in the cases of gradual onset.

*Bronchopneumonia Following Other Diseases.*—When bronchopneumonia follows pertussis, influenza, measles, or diphtheria it shows no variations from its usual course, but finds a lessened resistance because of what has gone before. The prognosis is therefore correspondingly less favorable, the disease being particularly fatal with or after pertussis, measles, and diphtheria.

**Complications.**—Among the complications, otitis is probably the most frequent. Empyema occurs in a small proportion of the cases. The same is true of pericarditis, meningitis, arthritis, and nephritis. Emphysema is always present to a slight degree, and except in rare instances is demonstrable at autopsy in fatal cases in young subjects. If the illness has been long, with considerable lung involvement, the emphysema may be very extensive.

**Differential Diagnosis.**—Bronchopneumonia is to be differentiated from acute bronchitis and lobar pneumonia. When the respiration is persistently above 40 per minute and the temperature persistently above 102° F., uncomplicated bronchitis does not exist, and pneumonic involvement of the lung is highly probable.

If there is an associated bronchial spasm increasing the respiration, a differential diagnosis is more difficult and sometimes impossible, as pneumonia may exist with a low temperature range.

In lobar pneumonia the well-defined consolidated area in the lung, the absence of bronchial catarrh, and the usually persistent high temperature (Fig. 71) are sufficient to establish the type of the infection. The x-ray is invaluable in arriving at accurate diagnosis.

The *age* of the patient may be of assistance. Lobar pneumonia is least common under two years of age, and the great majority of the cases of bronchopneumonia occur before this period.

**Prognosis.**—Bronchopneumonia is a disease of high mortality. In children's hospitals and institutions a considerable portion of the total mortality is due to bronchopneumonia. It is safe to say that from 25 to 50 per cent. of such hospital cases are fatal. This, of course, includes all cases of bronchopneumonia, those complicating whooping-cough, measles, scarlet fever, and diphtheria, as well as the terminal cases that occur late with many other ailments. The age and previous condition of the patient have a decided influence upon the mortality. The younger and feebler the patient, the less is the chance for recovery.

Rachitis, malnutrition, and marasmus are indirectly accountable for many deaths.

**Treatment.**—In treating bronchopneumonia it must be our effort to preserve every strength unit which the child possesses. An immense amount of vitality is wasted because of irritability, restlessness, and loss of sleep. One of the first duties in a given case is not to give this or that drug or use this or that local application, but to make the child comfortable.

**The Sick-room.**—The value of a constant supply of fresh air is too little appreciated. In every case there should be a direct communication between the sick-room and the open air throughout the attack. Various means of ventilation have been devised, of which the window-board (p. 26) is the most effective, as it separates the sash and allows the free entrance of a current of air which is directed upward. If plenty of fresh air at a proper temperature were available during the early part of the illness there would be much less use for tanks of oxygen later.

An absolute necessity in a sick-room is a thermometer. In pneumonia cases it should never register above 70° F. There is a marked tendency to coddle, to wrap, and to overclothe the patient. Even during the winter, absolutely nothing more is required than a medium-weight flannel shirt, a band, if one is ordinarily worn, and the usual night-dress. The oiled-silk jacket is cumbersome, cannot be kept clean, and overheats the patient. An infant with catarrhal pneumonia, heavily clad, in an unventilated, overheated room, and in close contact with an adult body, is tremendously handicapped. There is but one place for a sick infant, and that is in his own roomy crib.

**Diet.**—In every illness with fever the digestive capacity is considerably reduced. If the usual milk diet is continued a gastro-enteric infection may be added as a serious complication to the existing disease. For the breast-fed child a drink of water should be ordered just before the nursings and in the intervals between them. The nursing hours should be the same as in health, but the time allowed for each nursing should be reduced from one-third to one-half. For the bottle fed the milk strength should be reduced from one-third to one-half by dilution with water,

the quantity remaining the same. Children from two to four years of age should be restricted to a diet of diluted milk, gruels, and broths.

*Bowels.*—Normal bowel function is more necessary for the sick than for the well. There should be at least one stool in twenty-four hours.

*General Treatment.*—Having placed the child under the best dietetic and hygienic conditions, we are in a position to use medication to a much better advantage. But in its use, and in performing the various offices for the patient, it must be our effort to disturb him as little as possible. In our anxiety to do, we are very liable to overdo, with disastrous results. If a well child were given syrup expectorants, stimulants, baths, and local applications, something being done for him every hour or two in the twenty-four, he would have to be strong to withstand the treatment. We should treat our ill with still greater consideration. The intervals between which the child is to be disturbed at night should be made as long as possible by giving food, medicine, and local treatment at one time. When possible, we always endeavor to make the interval at least three hours.

*Steam Inhalations.*—Among the distinctly remedial measures steam inhalations with creosote deserve an important place. The patient is placed in the crib, which is covered and draped with sheets so as to make a fairly tight inclosed space. The apparatus necessary is an ordinary croup kettle. Ten drops of creosote added to 1 quart of water are poured into the kettle. The nozzle of the kettle is introduced between the sheets at a safe distance from the child's face and hands, the steaming being carried on for thirty minutes every three hours. The sheets should be parted slightly about every ten minutes to allow a renewal of the air. The inhalations are to be given whether the patient is asleep or awake. As he improves, they may be given less frequently until normal respirations and the chest signs tell us this treatment is no longer required.

*Counterirritants.*—The application of counterirritants to the skin over the thorax is of great service in cases in which there is much bronchial catarrh. This includes, of course, most cases. In order that a counterirritant may be of service a distinct red blush must be produced on the skin. Turpentine diluted with oil—one-third turpentine and two-thirds oil—when briskly rubbed on the parts for a few minutes produces a fairly satisfactory counterirritation. An objection to its use is the rare occurrence of albuminuria in a patient abnormally susceptible to this drug. The old-fashioned home-made mustard plaster has also served well. Written directions should always be given for the preparation of the plaster, and the boundaries of the area of the skin to be covered should be outlined with a pencil on the skin surface. If the nurse or mother is told merely to put a mustard plaster on the chest, a plaster the size of a man's hand will usually be placed somewhere between the umbilicus and the chin. For the first two or three applications 1 part of mustard to 2 parts of flour is used. This is moistened with warm water and made of the consistence of a rather thin paste, which is then spread upon cheese-cloth, old muslin, or linen, cut to the desired size. The plaster is readily held in position by a bandage or any thin material extending around the chest. When the skin is well reddened—usually within from five to fifteen minutes—the plaster is removed and vaselin or sweet oil is applied.

One should never use a plaster oftener than once in six hours, and then only in the severest cases. Ordinarily, two or three applications in twenty-four hours are sufficient. If the plasters are continued for several days, in order to avoid blistering it will be necessary to make them much weaker after a day or two—1 part of mustard to 5 or 10 of flour. Counterirritation is particularly effective when used at the commencement of an attack.

*Mustard Baths.*—In cases of sudden onset with high fever, rapid breathing, and cold extremities, a mustard bath—1 tablespoonful of mustard to 6 gallons of water at 110° F.—will often furnish marked relief from the immediate symptoms. The duration of the bath should be from one to three minutes, in which time the skin should be subjected to active manipulation by hand rubbing. The bath may be repeated at six-hour intervals.

This type of bronchopneumonia is usually very rapid in its development, the child being relieved or dead within thirty-six to forty-eight hours. By "relieved" we do not mean that recovery has occurred, but that the acute, urgent symptoms have subsided. In our opinion only these rapid cases should be considered primary. Autopsies on such subjects show a general congestion of the internal organs, with intense congestion of the lungs.

*Drugs.*—The internal medication is, to a large extent, symptomatic. It is particularly necessary that, in our endeavors to assist the patient, we do nothing to cause harm, for we are treating a disease in which resistance counts for everything. In illness with fever, with the accompanying nervous exhaustion, the stomach is most easily disturbed, the child is then not properly nourished, and his powers of resistance are markedly diminished.

Expectorants must be given with care, and are better prescribed in the form of tablets or powders. The use of heavy syrups of wild cherry, tolu, etc., with large doses of the ammonium salts, only adds to the burden of the patient. For a child one year of age with bronchopneumonia 1/100 grain of tartar emetic and 1/40 grain of ipecac answer well as an expectorant. If the cough is very severe and persistent, ¼ grain of Dover's powder in tablet form with sugar-of-milk, dissolved in at least 2 teaspoonfuls of water, may be given, preferably after feeding, not oftener than once in two hours. The ammonium salts so generally used in catarrhal pneumonia for routine treatment are badly borne by the stomach. Ammonium muriate is of some value during resolution, but to a child two years old it should not be given in larger doses than ¼ grain well diluted at two-hour intervals because of its irritant effect on the stomach.

In the event of high fever and great restlessness, which are not affected by sponging, and where, for any reason, rational bathing is impossible, a combination of caffeine, Dover's powder, and phenacetin may be used. To a child one year of age may be given ½ grain of caffeine, ½ grain of Dover's powder, and 1½ grains of phenacetin at four-hour intervals. In giving Dover's powder it is well to watch the bowels, as constipation often follows its use.

A heart stimulant should never be given simply because a child has pneumonia or diphtheria or scarlet fever, but it should be given in pneumonia or diphtheria or scarlet fever as soon as the heart needs assistance.

Briefly, there are two conditions to guide us—a very rapid pulse and a soft, not rapid, pulse, with a tendency to irregularity. As a general rule one may say that a heart which is beating at the rate of 150 a minute during quiet or sleep, and which is not strengthened by sponging or packs, needs assistance. The drug which is here indicated is digitalis, which acts as a direct stimulant to the heart muscle. The pulse, by its use, is made stronger, fuller, and less rapid. When the heart's action shows a tendency to irregularity, with a soft, easily compressible pulse, then strychnin is the remedy. Caffein sodiosalicylate in  $\frac{1}{2}$ -grain doses every two hours is also of much use in such a condition. To a child one year of age 2 drops of tincture of digitalis in water may be given every three hours, or 1/300 grain of strychnin every three hours, to be increased to 1/200 or even to 1/100 grain every three hours for a few doses, if the case is carefully watched for symptoms of strychnin-poisoning. Digitalis and strychnin possess advantages over all other stimulants in that they do their work and have no unpleasant effect on the stomach, as is the case with alcohol, digitalis, and the ammonium preparations. If the condition is very urgent, digitalis and strychnin may be used in combination. Alcohol in the form of whisky or brandy is very rarely of great service in catarrhal pneumonia. It may stimulate the heart, but its prolonged use greatly upsets the stomach. It should be withheld until late in the disease, when other means of stimulation fail. Then, given in large amounts, it may be the means of saving the patient:  $\frac{1}{2}$  dram of whisky or brandy, well diluted, may be given every hour or every two hours to a child one year of age. However, the cases of catarrhal pneumonia actually saved by the use of alcohol are few indeed. Nitroglycerin, 1/300 grain every three hours for a child one year of age, is of service in cases where there is marked cyanosis with cold extremities. Its use should be discontinued as soon as improvement in this respect is noticed. The one unpleasant feature observed from its administration is its tendency to produce headache and marked restlessness.

*Hypodermic Medication.*—In all urgent cases in which collapse is threatened, or when oral medication does not give results desired, one may employ the hypodermic, using the same dosage given by the mouth. Camphor may be given in 2-grain doses and repeated hourly if necessary. Digitalin, in dosage of 1/200 grain, may be given and repeated in three or four hours. For urgent collapse, camphor, and 1:1000 solution of adrenalin in dosage of 3 to 5 minims, are our best stimulants.

*Baths.*—A sponge-bath at 95° F. for cleansing purposes may be given daily.

*Pyrexia.*—What is to be our guide in dealing with the pyrexia? At what degree of temperature are we to interfere? This depends to a great extent upon what is behind the fever and the effect of the fever upon the individual patient. If a child has a high fever and is more comfortable when it is reduced, if he will digest his food better and sleep better, our duty is to reduce temperature. Further, by reducing it we lessen the work of the heart, saving many beats per minute. Usually, when the rectal temperature has a tendency to run above 104° F., interference is of advantage, and the best means at our command is the use of local applications of water in the form of sponge-baths or packs. If the temperature

is easily controlled, a sponge-bath will answer our purpose. Either salt or alcohol may be added to the water. Ordinarily, 2 teaspoonfuls of salt to 1 quart of water, or 1 part of alcohol to 3 parts of water, is ample. Cold water thus used serves two purposes—it acts as a sedative and it reduces the fever.

Cold sponging, while not as effectual as a bath or a pack, possesses the advantage of being applicable even in the hands of the most unskilled. For sponging, the child should be stripped and covered with a flannel blanket, the sponging being done under the blanket. In order not to antagonize or frighten him, it is best to begin with the water at 95° F. and gradually to reduce the temperature to 70° or 75° F. by the addition of ice or cold water. The sponging may be continued from ten to twenty minutes, and should not be repeated at shorter intervals than ninety minutes. After the sponging is completed the skin should be rubbed briskly for a few minutes with a dry towel. If the temperature is not readily controlled in this way, it is best to use other means, as too frequent sponging exhausts the patient. As a means of controlling the temperature in children the tub-bath has not proved successful in our hands. The exposure, the fright, and the necessary shortness of the bath render it very unsatisfactory.

By far the best means at our command for controlling a continued high fever is the cool pack (p. 841). Properly applied, it is without the slightest danger. A large bath-towel or any thick absorbent material may be used, slits being cut in one end of the towel through which the arms may pass. The towel should be folded over the body, and should extend from the neck to the middle of the thighs, the arms and the legs from the knees down remaining free. A hot-water bag, carefully guarded, should be placed at the feet. The towel is moistened with water at 95° F. It is well to make the pack warm at first, so that the child will not be frightened, as shock will thus be avoided. In two or three minutes the towel is moistened with water at 85° F., then at 80° F. When 80° F. is reached it is best not to make the water any colder for half an hour, at the expiration of which time the temperature of the patient should be taken. If, in the beginning, it is 105° F. and at the expiration of the half-hour shows slight or no reduction, the temperature of the pack may be reduced to 70° or even to 60° F. by the addition of cold water or ice, without removing the child, who is turned from side to side so that all parts of the enveloping towel may be moistened with cool water. During the first hours in the pack the temperature should be taken every half-hour, and when it is reduced to 102° F. the child should be removed and wrapped in a warm blanket. In cases of sudden and persistent high fever the child may be kept in the pack continuously. We aim to keep the temperature between 102.5° and 103.5° F. A fresh towel should be applied every three hours. An ice-bag should be kept at the head, a hot-water bag at the feet, and the patient should be covered with a flannel blanket of medium weight. The degree of cold necessary to control the fever in a given case will soon be learned.

The writer kept in a pack for seventy-two hours a four-year-old boy ill with lobar pneumonia. In this case a pack at 70° F. was necessary to keep the temperature at 104° F. or slightly lower.

*Oxygen* is of immense service in very severe cases with much lung involvement. It may be given for one or two minutes out of every seven or ten, or continuously with the funnel kept a few inches from the child's face. As often given, for one or two minutes every half-hour, it is of little or no service.

*Transfusion* is of value under the exceptional conditions which may call for its employment in lobar pneumonia (p. 367).

### INTERSTITIAL PNEUMONIA AND BRONCHIECTASIS

Interstitial pneumonia occurs in two types of cases. After bronchopneumonia the interstitial variety represents an unresolved pneumonia, and usually means that the individual has had more than one attack. The great majority of such cases are seen in ill-conditioned infants in hospitals and institutional homes. Rarely is this type seen in older children.

The second type represents the cases of unresolved pneumonia, usually lobar pneumonia, which have been complicated by empyema, and in which the empyema has not been recognized or has been improperly treated.

**Pathology.**—Chronic interstitial pneumonia is a productive inflammation characterized by thickening of the connective-tissue framework of the lung. This disease follows one or more attacks of bronchopneumonia or may accompany a chronic empyema. The process may involve one or more lobes of the lung or only a portion of one lobe. The involved lung is usually adherent to the chest wall by very dense fibrous adhesions, and is smaller than normal, firm, and grayish in color. On section, the pleura and connective-tissue septa are found to be greatly thickened. The bronchi are often dilated, and may be the seat of purulent bronchitis.

Microscopic examination shows that the interlobular septa, the walls of the bronchi and blood-vessels, and the alveolar walls are thickened with connective tissue. As a consequence some alveoli may be obliterated.

Compensatory emphysema is often present in a portion of the unaffected lung.

**Symptoms.**—Not half the symptoms described by writers exist. The principal manifestation is afforded by the condition of the patient, who is anemic, emaciated, and fails to thrive, or improves but slowly even under the best surroundings.

There may be cough and, rarely, fever. The respiration is accelerated upon exertion, but otherwise shows no change. If there is an associated bronchiectasis, in older patients there will be mucopurulent or purulent expectoration.

*Illustrative Case.*—A boy for several years expelled free expectoration about once a day. There was an interstitial pneumonia involving the lower half of the right lung, which was the seat of one or more bronchiectatic cavities. The pus evidently collected periodically and filled the cavity, then producing cough and emptying of the cavity.

**Diagnosis.**—*Inspection.*—There may be extensive retraction of the chest wall or none at all, depending on the age of the patient. In infants under eighteen months there is rarely such retraction.

Upon forced inspiration, as in crying, it will be noticed that the chest wall over the involved lung area fails to take part in the normal respiratory excursion. Older children exhibit varying degrees of retraction, usually associated with spinal curvature.

*Auscultation.*—The respiratory signs are subject to wide variations. Thus in one case there may be bronchial breathing over one diseased area and entire absence of the respiratory murmur over another area. Between these extremes in the same case there may be a variety of abnormal respiratory sounds. Over the uninvolved lung the respiratory murmur undergoes pronounced exaggeration. If there is a considerable bronchiectasis, signs of a cavity will be indicated by amphoric breathing.

*Percussion* invariably shows localized dulness over the diseased portion of the lung. One may find all shades of dulness to flatness. Over the free portion of the lung hyperresonance will be found because of the emphysema, which is always present in slight or moderate degree.

x-Ray examinations are of great value, if repeated over a considerable period of time, in showing recession or extension of the process.

**Differential Diagnosis.**—The question that always arises in these cases relates to the possibility of tuberculosis. A considerable number, particularly under two years, do develop tuberculosis. An examination of the sputum and the intradermal tuberculin test should invariably be made. In cases in young infants a positive tuberculin reaction supplies reliable corroborative evidence. Repeated examination of the bronchial secretions (p. 396) will reveal the tubercle bacillus if it is present. When the lesions are tuberculous in older children examination of the sputum quickly determines the diagnosis.

**Prognosis.**—The prognosis in an infant is very unfavorable. If tuberculosis does not develop, intercurrent disease, such as the intestinal disease of summer, whooping-cough, measles, or acute pneumonia, will very likely terminate the case. Recovery is not impossible, however, and infants have been observed to make almost complete recoveries after the process had existed for months. In one case the child's chest did not begin to "clear" until after the third month. In recovery cases the interstitial change cannot have been at all extensive.

In an older child after the sixth year a favorable prognosis as regards life is the rule. Whether the case follows bronchopneumonia or pneumonia with empyema, even with the best results, there will be left a more or less crippled lung, which does not necessarily compromise the later well-being of the patient. Such patients, however, are more liable to tuberculous infection, and this possibility is always to be taken into consideration in their management.

**Bronchiectasis** is present in a considerable number of cases of interstitial pneumonia, both in the young and older children, consisting of dilatation of the bronchi, usually sacculated or cylindric in form.

*Illustrative Case.*—The lungs of a child eighteen months of age who died from bronchopneumonia of three months' duration, with terminal sepsis, presented several small cylindric dilatations. One of these, with a capacity of 6 drams, was found in the right lung. This case is similar to many seen at autopsy.

In young infants bronchiectasis may be very difficult of demonstration. In the cases of older patients the expectoration of pus in a chronic pneumonia is very suggestive, and in such instances physical examination may reveal amphoric breathing and other signs of cavity.

Dilatation of a bronchus may be cylindric, sacculated, or spindle shaped. It is accompanied either by atrophy or by hypertrophy of the mucosa and of the entire bronchial wall. Dilated bronchi contain thick mucous or purulent secretion, often in very large amount. The secretion may be blood-stained, due to rupture of some of the very numerous blood-vessels in the hypertrophied mucosa. Pressure of the dilated bronchi often causes collapse of the pulmonary alveoli surrounding them. The walls of neighboring bronchi may fuse, forming larger cavities.

**Treatment.**—The treatment of interstitial pneumonia is not particularly brilliant in results. There is always the hope that the interstitial process dependent on cicatricial change is not extensive, for this feature determines in no little degree the outcome of the case. When resolution takes place, it occurs always from the periphery toward the center of the diseased part. The involved area becomes smaller and smaller and disappears, or, more frequently, as the ultimate outcome, an area of weakly vesicular breathing remains to mark the site where the disease was most active.

Little can be accomplished by the use of drugs except to improve the nutrition of the patient. Children with this unfortunate pulmonary disease should take up their permanent residence in a dry climate, like that of Colorado or New Mexico. A visit of a few months or a year is of but little service. The writer used the iodids and the bichlorid of mercury for months without any appreciable improvement in two of these patients who could not be removed from town. The citrate of iron and quinin, 1 grain in a dram of sherry wine, makes a good appetizer, and may be given in  $\frac{1}{4}$  glass of water after meals. Its use can with advantage be alternated with that of the syrup of the hypophosphites (Gardner), 1 to 3 drams being given daily in  $\frac{1}{2}$  glass of water after meals. Cod-liver oil may be used with advantage for ten days out of the month, but its continued use is contraindicated, as it is apt to interfere with digestion.

*Illustrative Case.*—In one of the cases above referred to the iron was given for ten days and the oil for ten days, after which the procedure was steadily repeated. The patient continued to look well, gained in weight, and remained under treatment until he took up an occupation and passed from observation. The condition of the lung had remained unchanged, the only active manifestation of the disease being the expectoration of a considerable amount of non-tuberculous pus every morning on rising.

Whenever periodic accumulations of pus are demonstrated the child should practice leaning over a chair at least twice daily with head and trunk inverted to facilitate evacuation of the cavity. Frequently after such a maneuver with its attendant coughing up of expectoration there will be localized hyperresonance and amphoric breathing where a few minutes previously had been dulness and diminished breath sounds. It is desirable that the cavity should be distended by accumulation of secretion as little of the time as possible.

Infants and children with bronchiectasis who cannot be removed

to a favorable climate should have the advantages of outdoor life, and older children should have as much active exercise as is possible without fatigue. The diet and general management are the same as for pulmonary tuberculosis (p. 397). In a considerable number of cases under observation at Bellevue Hospital creosote has been continuously administered, with apparently good effect.

*Gymnastic Therapeutics.*—For the purpose of expansion of the lung with the hope of curing the chest deformity gymnastic exercises are of the greatest value.

### INSUFFLATION PNEUMONIA

Following the aspiration of foreign material into the lower air-passages pneumonia may rapidly develop. In the case of aspiration of a single foreign body such as a seed or kernel the process may be definitely localized. When the insufflation takes the form of aspiration of vomitus under anesthesia or is produced by direct mechanical action, such as may occur when blood or secretions are forced downward under anesthesia administered intranasally or intratracheally by a tube, the pneumonia may be disseminated. This form of pneumonia is the type probably most frequently developing in infants or in children with low vitality who undergo cleft-palate repair, retropharyngeal abscess incision, and tonsillectomy under deep anesthesia.

The possibility of the occurrence of pneumonia of this type should never be overlooked by operators or anesthetists.

The accidental aspiration of stearate of zinc by infants is a well-established cause of asphyxia and lung irritation with lesions which may give rise to areas of consolidation and give the physical signs and symptoms of bronchopneumonia even though cultures from lung tissue taken postmortem may be found sterile.<sup>1</sup> The loosely capped talcum powder box should, therefore, be regarded as a dangerous toy.

### HYPOSTATIC PNEUMONIA

Hypostatic pneumonia is a form of lobular pneumonia which develops in fatal cases in the most dependent portions of the lungs, these portions having become very hyperemic as the result of weakness of the heart and respiration in patients who are severely ill.

The affected pulmonary tissue is dark red in color, very firm, and airless. On section, the cut surface is red and very moist, exuding blood freely. Microscopically, the capillaries and veins are distended with blood, and the alveoli are filled with red blood-cells, leukocytes, and desquamated epithelium. The bronchi are usually in good condition. The extent of the consolidation varies. While it usually occupies only a superficial strip along the posterior border and base of the lungs, fully half of the lower lobes may be involved.

### PNEUMOTHORAX

Air in the pleural cavity may be due to tuberculosis or to trauma (usually through exploratory puncture) causing perforation of the lung. We have seen only one or two undoubted cases of this nature. Pneu-

<sup>1</sup>Heiman and Aschner, Amer. Jour. Dis. Child., June, 1922.

mothorax also may occur in empyema. By far the most frequent cause in children is the formation, by a tuberculous cavity, of a communication between a bronchus and the pleural cavity.

Artificial pneumothorax is employed as a means of treatment in selected cases of tuberculosis.

**Symptoms.**—In the tuberculous cases of pneumothorax the symptoms comprise very sudden onset of urgent collapse, urgent dyspnea, cyanosis, and rapid, feeble pulse. In cases due to trauma the symptoms may be urgent or scarcely noticeable, depending upon the extent of the lesion. In a case which developed after exploratory puncture, only a moderate amount of air entered the pleural cavity and no inconvenience was occasioned.

**Physical Signs.**—The physical signs are determined largely by the amount of air entering the pleural cavity. They may include simply



Fig. 74.—Pneumothorax resulting from traumatic rupture of the right lung which appears as a solid mass close to the midline. (Children's Medical Division, Bellevue Hospital.)

hyperresonance and absence of respiratory sounds. In cases of tuberculous origin there is usually a sudden inrush of air, with resulting immobility of the affected side and enlargement of that side of the thorax. There is marked hyperresonance, and an absence of fremitus. In cases in which the amount of air is not excessive there will be tympanitic dullness. Displacement of the heart by the accumulated air under pressure may be demonstrated in extreme cases.

*Auscultation* reveals very weak breath sounds or entire absence of the same. The coin test is very diagnostic. A coin is placed on the chest, either anteriorly or posteriorly, and tapped with another coin by an assistant, while the ear of the examiner is placed on the opposite aspect

of the same half of the chest. The sharp metallic sound conveyed, in comparison with the absence of sound over the opposite lung, furnishes a demonstration to students that will never be forgotten. If there is fluid in the pleural cavity, splashing, metallic, tinkling sounds may be heard.

**Diagnosis.**—A rare condition in which the diagnosis of pneumothorax has wrongly been made is *congenital diaphragmatic hernia*. Tympanitic coils of intestine in the thoracic cavity of a child ill with bronchitis or pneumonia strongly suggests pneumothorax. Radiographs not only of the lungs but also the gastro-intestinal tract are essential to give a satisfactory demonstration in such an instance.

**Prognosis.**—The prognosis depends upon the cause of the air in the pleural cavity. The tuberculous cases are rapidly fatal. After trauma the recovery depends upon the nature of the injury. In the cases following exploratory puncture recovery without treatment is common.

**Treatment.**—In complicating empyema the fluid should be removed by surgical procedures. If there is marked displacement of the heart and considerable intrathoracic pressure, tapping the chest with a needle, and allowing an escape of the air, may be of value, particularly if a valve-like action at the aperture in the lung has induced extreme compression of air in the pleural cavity.

### EMPHYSEMA

Emphysema is a secondary disease. There are few autopsies on children dying from pulmonary disorders in which it is not found present in greater or less degree. It is always present in considerable amount in cases of interstitial pneumonia, and in this association the emphysema is compensatory in character. It is found with whooping-cough, bronchopneumonia, habitual spasmodic bronchitis, and true asthma.

**Pathology.**—Emphysema is most frequently found in a pronounced degree in the upper lobes, especially at the anterior borders and the apices. The air-vesicles are persistently dilated, and on inspection, to the unaided eye, present a picture of innumerable pin-point air-bubbles. When the septa give way the vesicles enlarge so that blebs of various size occur. The condition rarely becomes interlobular.

**Symptoms.**—In many cases there is no special manifestation, and the fact that emphysema exists is discovered only at the autopsy. This is particularly common in compensating cases in which there is a good deal of lung involvement, as in interstitial pneumonia or in prolonged bronchopneumonia.

When there has been repeated spasmodic bronchitis or true asthma, there is shortness of the breath, with rapid breathing, and the thoracic wall presents a fixed appearance owing to the diminished or imperceptible respiratory excursion.

The so-called barrel-shaped chest is seen in children, but is of comparatively infrequent occurrence.

The child usually has a dry cough, is incapable of the usual exertions of early life, and readily becomes cyanosed through air-hunger.

**Physical Signs.**—*Percussion.*—There is increased resonance on percussion, general in distribution, but most marked over the upper lobes

in front. When the emphysema is not excessive tympanitic dulness may be elicited. The area of cardiac dulness may be much smaller than normal or entirely obliterated.

*Auscultation.*—Upon auscultation the respiratory murmur is found to be feeble, and expiration is noticeably prolonged and longer than inspiration. Squeaking, small, dry râles are usually heard in children because of the almost invariable association of bronchitis. The râles are heard both on inspiration and on expiration. The respiratory sounds have been aptly described as wheezing in character.

*Prognosis.*—The prognosis in general emphysema is unfavorable. The attacks of recurrent asthma or recurrent spasmodic bronchitis, which induce the process, continue, and the condition becomes most pitiable. Dilatation of the right heart ultimately occurs. Cardiac failure and acute pulmonary disease are the usual terminal affections.

*Treatment.*—The management is that of the associated condition.

#### SUBCUTANEOUS EMPHYSEMA WITH EMPHYSEMA OF THE MEDIASTINUM

This is a rare condition in children. Before the use of intubation, when tracheotomy was in vogue, many more cases were seen than now. Other causes may be pertussis, tuberculosis, or trauma to the lung. The first site affected is typically the mediastinum, whence the emphysema extends to the subcutaneous tissues and is particularly apt to appear above the clavicles, where it produces a cushion-like effect. In one case the emphysema extended from this point downward over the thorax, and upward, involving the entire neck.

*Prognosis.*—Cases following operative procedures and trauma may undergo recovery. When the condition is a complication of pulmonary disease the outlook is very unfavorable.

#### PRIMARY PLEURISY

Acute, primary pleurisy is a very rare condition in children. Of 5 patients with this condition, under nine years of age, 1 was eight; 1, seven; 1, four years of age; 1, two and a half years, and 1, only fifteen months old.

*Pathology.*—In these cases there is inflammation of the pleura with exudate, but usually not sufficient inflammation to produce an appreciable exudate.

*Symptoms.*—The onset of the disease is practically the same as in adults. There is localized pain—the so-called “stitch in the side”; the respiration is rapid—40 to 60 to the minute—and shallow; the skin is dry and hot; the cough is teasing, and, on account of the pain which it causes, is partially suppressed by the patient. Fever is present, usually ranging from 102° to 105° F. The pulse is rapid—120 to 150 to the minute. In two cases the pleuritic inflammation was followed by effusion. The fluid in both cases was sterile. So far as we could learn there was no associated rheumatism in any of the cases.

*Treatment.*—The treatment which proved successful in the 5 cases cited was rest in bed. The patients were given a reduced diet of milk,

broths, and gruel. The fever was not of a very persistent character and was readily controlled by sponge-baths. A flaxseed and mustard poultice - 1 part of mustard to 9 parts of flaxseed—applied as hot as could be borne by the back of the nurse's hand, and changed every half-hour, gave much relief from the pain during the acute stage. After the first twenty-four hours, however, poultices are of little value. Strapping the affected side with strips of Z. O. plaster will give much comfort when the pain continues after the second day. Tincture of aconite in doses of 1 drop every hour may be given to older children until 10 drops have been given. This has produced a fairly free diaphoresis and made the patients more comfortable. A grain of calomel in divided doses may be given early in the attack, 1/10 grain being given every ten or fifteen minutes. To relieve the cough, small doses of codein, 1/10 grain every two hours, may be given the older children.

The duration of the acute symptoms is ordinarily from twelve to twenty-four hours, the entire duration of the illness ranging from five days to one week.

In the case of effusion in our youngest patient absorption appeared to be stimulated by the introduction of the needle and the withdrawal of a small amount of fluid, the remainder quickly disappearing afterward.

**Ultimate Results.**—That the cases observed were not of tuberculous origin was strongly indicated not only by the absence of the tubercle bacilli, but by the complete recovery and continued good health of each patient during the next few years.

## SECONDARY PLEURISY

**Etiology.**—This form of pleurisy is of very frequent occurrence in the young, and in by far the larger number of cases occurs as a complication of pneumonia.

Tuberculosis is probably the next most frequent cause.

Secondary pleurisy may occur with pericarditis; such an association, however, is rare.

**Bacteriology.** - Acute fibrinous (dry) pleurisy accompanying pneumonia in children is caused by the identical micro-organism found in the consolidated areas of lung tissue. This type of pleurisy is more common with lobar pneumonia than with bronchopneumonia.

In acute serous pleurisy accompanying pneumonia small numbers of pneumococci may be found in the fluid. Clear, serous, pleural fluid containing streptococci has been described.

In the tuberculous cases the fluid contains the tubercle bacillus, demonstrable by staining methods or by intraperitoneal injection into guinea-pigs. On ordinary culture-media tuberculous serous fluids give no growth.

Pleurisy with serous effusion may occur with acute rheumatism.

**Pathology.**—Following or coincident with pneumonia there may occur what is known as dry pleurisy, or pleurisy with effusion. When dry pleurisy exists, the pleura loses its usual luster, and, early in the attack, is covered with a slight fibrinous exudate. Exudation may go no further than this, or it may become most extensive, resulting in a

network of fibrinous bands, in the meshes of which there is a thick, gelatinous mass composed largely of fibrin and pus-cells.

Repeatedly at autopsy the lung will be found so thoroughly bound to the chest wall that its removal without the aid of force is impossible.

In pleurisy with effusion a fluid composed either of pus or of serum will be found in the pleural cavity. We have never seen such a case of pleurisy secondary to pneumonia in which the effusion did not contain bacteria. The fluid upon withdrawal may appear clear, yet bacteriologic examination will show that it is not sterile. The evidence of bacteria in the fluid may be, and often is, the first manifestation of a purulent pleurisy or empyema.

Pleurisy of tuberculous origin may or may not be of the dry type. Tubercles may be found on the pleura, and there is more or less exudation of fibrin. If the process is an old one, there is considerable thickening of the pleura, with very firm adhesions. Effusion, when present in this type, often exists in small amount—1 to 4 ounces—sacculated, and may be serous or purulent.

**Symptoms.**—Secondary pleurisy rarely exhibits distinct symptoms of its own. The manifestations are a part of the disease which the pleurisy complicates. There may be localized pain, but this is rarely of an active type. A sensation of tightness or constriction is more common, and it is surprising how little discomfort is present in a vast majority of the cases. When fluid is formed, whether serum or pus, there are, again, no active symptoms unless the fluid is excessive, in which event there will be interference with respiration, and, if the process is on the left side, the heart will show the effects of the pressure by rapidity and perhaps irregularity.

The influence that the pleurisy exerts upon the temperature is difficult to determine, as the process is secondary to diseases in which temperature is a prominent feature. If the exudation is purulent, the temperature may take on the characteristic morning drop and evening rise. This will be very apt to occur in case of purulent exudation following pneumonia (p. 388).

**Diagnosis.**—The diagnosis is dependent more upon the physical signs than upon the symptoms.

**Auscultation.**—In the cases without fluid exudate auscultation will often detect either fine friction râles, which may be heard only at the end of inspiration, or the dry rubbing friction crepitus heard with both inspiration and expiration. In the presence of fluid there may be weakness of, or absence of, respiratory murmur over the area covered by the exuded fluid, and the characteristic egophony at the level of the fluid. Râles will be absent. Over the uninvolved lung area there will be an exaggeration of the normal respiratory sounds.

**Percussion.**—In dry pleurisy there is no perceptible dulness. The child may complain that the percussion is painful. With fluid there will be dulness or flatness, depending upon the amount of fluid present. A small amount usually gives circumscribed dulness; a large amount, extreme dulness or flatness. Over the uninvolved portion of the lung there will be hyperresonance. With a large accumulation the heart may be displaced.

*x-Ray.*—Radiographic findings are usually definite, but do not always give the differentiation clearly between fluid and consolidation.

*Exploratory puncture* if successful not only definitely determines the presence of fluid but also its nature.

**Treatment.** The treatment of dry secondary pleurisy is usually that of the disease which the pleurisy complicates. We have never known special medication to be of any practical value. Tonics and supportive measures generally are of service. Anything that will improve the condition of the patient should be brought into use. A change of residence from the city to the country for those who can afford it, or an outdoor life in the city for those who cannot avail themselves of such a change, is always beneficial.

Counterirritation to the chest with mustard or iodine will often give relief to the patient if there is pain, but otherwise this measure possesses no value. When there is a sense of "tightness" and constriction of the chest which amounts to pain counterirritation will relieve the discomfort. The application of a mustard plaster (p. 846)—one-third mustard and two-thirds flour—to the bare skin over the diseased area for ten or fifteen minutes, at intervals of six or eight hours, will add to the comfort of the patient. Painting the affected area with tincture of iodine every second or third night has, in a few cases, afforded some relief. The administration of iodids as an aid to absorption is of questionable value, and is very apt to disturb the digestion.

When, after recovery from the pneumonia or the empyema, adhesions persist compelling restricted lung action, active exercise in the open air is to be encouraged. For younger patients horseback-riding, the bicycle, and breathing exercises, with physical games which call for active interest and require deep breathing give the best results.

*Presence of Fluid.*—If the exploratory puncture shows the presence of serum, the fluid is best left, with the hope that it will be absorbed, unless it is in sufficient amount to compromise the respiratory function and the action of the heart. In such an event as much as possible without undue inconvenience to the patient should be removed by aspiration. In many cases the fluid rapidly disappears after one aspiration. If this outcome is not attained, aspiration is to be repeated.

During this operation care should be exercised to observe absolute asepsis. We have known clear exudate to become rapidly purulent after the insertion of a needle. There is always a question in such instances, how much infection has been carried in on the needle. The skin should be thoroughly scrubbed with green soap. This is to be followed by washing with alcohol, and then with equal parts of alcohol and tincture of iodine. The hands should be cleaned, and the instrument used should be sterilized, as for a surgical operation.

If the pleurisy is of tuberculous origin no particular management is demanded other than that of the primary disease, except in the event of symptoms of pain. This is to be relieved, as already described, by the use of local applications of mustard and iodine, with perhaps the administration of a sedative, such as small doses of codeine.

Dry pleurisy associated with pericarditis does not call for treatment other than that of the pericarditis.

## EMPHYEMA (PLEURISY WITH PURULENT EFFUSION)

In empyema there is a collection of pus in the pleural cavity, resulting from inflammation of the pleura which has become infected with pathogenic organisms.

**Age.**—A vast majority of the cases occur in infants and children under four years of age. The senior author's youngest patient was three weeks old, and this child recovered. Comparatively few cases develop after the tenth year.

**Etiology.**—In 95 per cent. of our cases the disease has occurred with evident pneumonia. Empyema may follow suppurative processes in any part of the body, but such cases are extremely rare.

**Bacteriology.**—The pneumococcus is found in pure culture in the pus in about 75 per cent. of all cases in children. The streptococcus is less commonly present, and the Staphylococcus aureus is very rarely found. Bacillus influenza has been found in pure culture in purulent pleural fluid after influenzal pneumonia, and B. typhosus may cause empyema during an attack of typhoid fever. From empyema following inflammatory conditions in the abdomen (appendicitis or peritonitis) B. coli communis has been isolated.

Purulent effusion accompanying pulmonary tuberculosis may contain the tubercle bacillus, but pyogenic cocci also are almost always present.

**Pathology.**—A purulent pleural exudation may follow serous inflammation of the pleura, or the process may be purulent from the outset. The pus may be thin or thick, yellowish or greenish in color, and may contain large masses of fibrin. The quantity of purulent fluid may vary from a few ounces to 30 to 40 ounces or more in neglected cases. While the inflammation may involve the entire pleural surface of one lung, and even involve both pleural cavities it is more often limited to the lower lobe and to the posterior portion. The pulmonary and costal surfaces of the pleura are usually covered with a fibrinopurulent exudate, and adhesions between the pleural surfaces and between the pleura and pericardium are readily separated at this stage. The lung substance beneath the exudate is more or less compressed, according to the amount of pus present. In extreme cases the affected lung portion may be completely airless, bloodless, gray in color, smaller than normal, and flattened against the vertebral column. The heart may be pressed toward the healthy side. In less severe cases the lung may be congested and still contain some air.

Empyema may heal completely in the early stage. Very often, however, it tends toward a chronic course. The pus frequently becomes very thick, and the formation of granulation tissue, and later of fibrous connective tissue, causes irregular thickening of the pleura. Adhesions between the pleural surfaces may thus be so dense as to make separation impossible, and an encapsulated empyema may be formed by the shutting off of a smaller or larger amount of pus by adhesions. The connective-tissue formation may finally extend into the lung substance, resulting in interstitial pneumonia.

In cases of empyema which come to autopsy early in the disease the pneumonia preceding the empyema may still be present. In later stages,

however, only a complicating bronchopneumonia, acute or chronic, may be found in one or more of the lobes not involved by the empyema, or an interstitial pneumonia in that portion of the lung substance beneath the thickened pleura.

In untreated cases the pus may be evacuated through a bronchus, externally through the chest wall, or into the peritoneal cavity. When absorption and spontaneous "cure" occurs without rupture fibrosis of the lung is frequently produced.

**Symptoms.**—*Empyema after Bronchopneumonia.*—The child has bronchopneumonia, running the usual course as to fever, respiration, pulse, and prostration. After a time varying from six to twelve days an improvement in the symptoms is noticed; the pulse and respiration become slower, and the child appears brighter. During the height of the pneumonia the temperature has been perhaps 104° to 105° F. Now it ranges

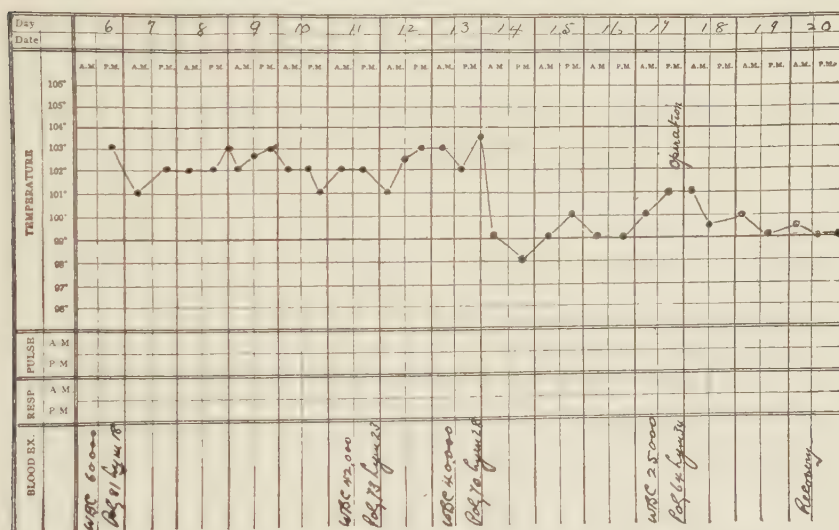


Fig. 75.—Temperature chart. Emphyema following lobar pneumonia.

from 100° to 102° F., at times dropping to 99° F. For twenty-four to forty-eight hours the temperature range is quite low. Soon it becomes noticeable that the fever is higher in the evening than in the morning, although the evening temperature may not be above 102° F., or at most 103° F. The child coughs, the pulse is rapid—120 to 140—and the respiration is accelerated to 40 or more. The appetite is poor. These or similar symptoms may continue for weeks if the condition is not recognized.

*Empyema After Lobar Pneumonia.*—Empyema more frequently follows lobar pneumonia than bronchopneumonia. The following symptomatology covers a majority of the cases: The crisis occurs, and the temperature falls to normal (see Fig. 76) and remains normal for a few days; or perhaps there is the temporary postcritical rise the day following the crisis. In other respects conditions continue favorable for perhaps two, three, or rarely five days, when a slight evening rise in temperature oc-

curs. The temperature is lower the next morning, but perhaps not quite normal; the following evening it is higher than the preceding, and the next evening it is still higher. Such a temperature range following pneumonia is almost pathognomonic of empyema (Fig. 76).

In some few cases the exudation of pus into the pleural cavity is not delayed until the temperature falls, but develops during the first few days of the pneumonia. With the formation of pus the respiration and pulse increase in frequency, the respiration ranging above 40, and the pulse from 140 to 180. It is a mistake, however, invariably to expect characteristic signs. The lungs and heart soon accommodate themselves to the changed conditions. Repeatedly we have seen cases in which there was but slight acceleration of the pulse and respiration. The evening temperature, however, is rarely less than 102° F. In addition to the symptoms enumerated, these cases particularly those that

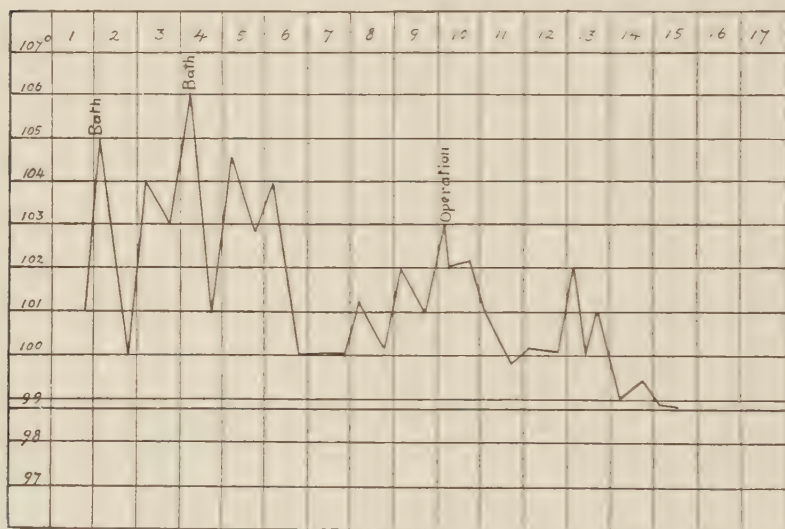


Fig. 76.—Empyema following lobar pneumonia. Operation. Recovery case.

have continued for two weeks or longer) show a symptom-complex that may almost be said to be characteristic. The child is emaciated and his face wears an anxious expression. The skin is pale, of a yellowish tinge, and perspires readily. The mucous membrane and conjunctivæ are pale. Slight exertion causes embarrassment of the respiration. The nostrils are distended; the respiration during rest is short, and increased from 10 to 20 per minute above the normal. The fingers may show signs of clubbing. The blood, which has perhaps shown during the pneumonia a leukocytosis ranging from 15,000 to 25,000, with the development of empyema may afford leukocyte counts of 35,000 or higher.

**Diagnosis** is based upon physical examination of the chest, x-ray examination, and exploratory puncture. Weakness or absence of respiratory murmur and absence of râles, combined with the presence of dulness or flatness, are indications justifying an exploratory puncture.

When the disease is located on the left side, the displacement of the heart to the right, as indicated by the changed position of the apex-beat, is a very suggestive sign. Over the uninvolved portion of the chest auscultation will show exaggerated respiratory murmur; and percussion, hyperresonance.

**Differential Diagnosis.**—Empyema is to be differentiated from serous pleurisy, pleurisy with massive exudation of fibrin, unresolved pneumonia, pulmonary tuberculosis, malaria, pyelitis, otitis, and typhoid fever. The value of routine blood and urine analysis in such differentiation is at all times to be kept in mind.

Serous pleurisy and pleurisy with a thick, fibrinous exudate give signs identical with those of empyema. In many cases of fibrinous pleurisy with a considerable exudate not a râle or friction sound will be heard. Our only means of differentiating empyema from these processes is exploratory puncture with a large needle.

In unresolved pneumonia the respiratory sounds are heard with greater distinctness. Râles, and often friction sounds, are present. The dulness is distinctly localized, and there is rarely flatness unless there is associated with the pneumonia a thick pleuritic exudate.

In tuberculosis of the lung of sufficient gravity to allow of confusion the presence of tubercle bacilli in smears from the expectoration or tracheal secretion (see p. 396) may determine the diagnosis. The intradermal tuberculin test (p. 825) and x-ray examinations may be brought into use. Here also, however, the exploratory puncture is the best means of establishing the diagnosis.

The difficulties in differentiating typhoid fever and malaria from empyema should be slight in view of the marked dissimilarity in the disease conditions. Nevertheless, cases of pleurisy are not infrequently treated for typhoid and malaria when pus is present in the pleural cavity. Whenever the lungs are proved normal by competent physical examination, the tests for malaria and typhoid in daily use should be instituted.

**Treatment.**—When pus is located, *operation and drainage* are the only methods of treatment. Aspiration is never to be looked upon as a substitute for incision.

In a recent case in a young child under two years of age an incision with local anesthesia—ethyl chlorid answers the purpose—is at times permissible. In the case of an older child, or in a prolonged case in a young child, partial resection of a rib under general anesthesia is to be advised as furnishing much freer drainage. Occasionally cases are seen among older children in which, on account of a very severe, persisting pneumonia, it will not be safe to use a general anesthetic. In such cases an incision may be made under novocain—a 1 to 2 per cent. solution being injected into the skin at the site of the proposed incision. Such an operation will relieve the immediate symptoms—the displacement of the heart and the difficult breathing. The resection of a rib may safely be undertaken after a week or two, when considerable improvement will have taken place in the general condition. As soon as the cavity is opened, two  $\frac{1}{2}$ -inch drainage-tubes, from 2 to 4 inches in length, joined with a large safety-pin, are inserted. Gauze is packed around the tubes and

against the skin, and upon this the pin rests. Sterile gauze is placed over the end of the tubes as soon as possible after their introduction in order to prevent too free escape of pus. When the pus is allowed gradually to escape, much less shock will be experienced. Over the gauze two or three layers of absorbent cotton are placed, and over this the bandage. The dressing should be changed every day and the tubes shortened as the lung expands. This expansion will be indicated by the resulting outward displacement of the tubes. After the evacuation of the pus the pulse usually falls to normal or nearly normal, where it remains. Occasionally, however, this expected result does not follow the operation.

*Illustrative Case.*—In one case the operation was followed by a free discharge of pus, but with no relief whatever to the symptoms. An examination of the chest revealed at the apex of the lung a pocket of pus which had become walled off by adhesions. The case was one of three months' duration when it came under the writer's care. A second operation removed about 6 ounces of pus, but the child died from exhaustion about twenty-four hours afterward. Autopsy showed that the pleural cavity was divided into two distinct pus-sacs by a firm band of adhesions.

Failure of the temperature to subside in our cases in which complications could be excluded has been due to defective drainage. The tube may be too small or plugged, or the pus may become sacculated. Large fibrinous masses which the tube will not admit may undergo slow degeneration and absorption and continue the temperature.

*Illustrative Case.*—In a case of empyema following pneumonia of great severity in a girl of five years, on account of the reduced condition of the child, an incision was made instead of a resection of the rib. The temperature fell to normal, and all the symptoms improved for a few days, when an evening rise to 101° F. was noted, which in two or three days reached 103° F. There was a discharge which saturated the dressings, although they were changed every three or four hours. Our inability to locate an independent pus-pocket, the continued fever, and a strong odor to the discharge suggested the probability of insufficient drainage. In spite of the fever, the child having gained considerably in strength, a second operation was decided upon to enlarge the wound. She was anesthetized, and 2 inches of rib were removed, whereupon quantities of necrotic fibrinous material were found in the pleural cavity. These were removed with the finger and dressing forceps; the temperature immediately fell to normal, and the child made a perfect recovery. Irrigation of the cavity had been of no avail.

Ordinarily the tubes should not be removed until from two to six weeks after the operation. At least one tube should be kept in position until a free respiratory murmur is heard all over the affected side, up to the site of operation in the chest wall. When the lung is fully expanded the tubes will be forced out and found in the dressings. Irrigation of the pleural cavity with Carrel-Dakin solution is at times of value, but with sufficient drainage is rarely found necessary. The cases which require irrigation on account of continued fever and insufficient discharge require the resection of a rib. Should a second operation be refused, on account of the tender age or the general weakness of the patient, or be inadvisable on account of some complication, such as a pericarditis, a daily irrigation with the Carrel-Dakin solution may be undertaken.

*Deformity Following Untreated Cases.*—In hospital and out-patient work cases neglected for weeks, showing marked chest deformity and retraction, usually associated with spinal curvature, are among those

treated. The pus has been partially absorbed and partially organized, leaving extensive adhesions which have bound the lung tightly to the chest wall, preventing expansion, so that the bony wall has become displaced inward to meet the lung. For these unfortunate children surgical measures furnish some relief, but the results have not been brilliant.

*Suction Drainage.*—Various methods have been devised to favor the escape of pus without the admission of air to the pleural cavity. Such methods are undoubtedly of value in selected cases, particularly when the pus content is not thick or marked by the presence of large amounts of pyogenic membrane. The old-time practice of rib resection and drainage is, however, still favored by many conservative surgeons.

**Double Empyema.**—But 2 cases coming under our observation have had both pleural sacs involved. In such cases both sides should not be opened at the same time, on account of the danger of collapse of the lungs. There are usually adhesions present sufficiently strong to prevent this, but we have no means of knowing beforehand. In both of the cases the left pleural cavity was opened first in order to relieve the pressure upon the heart and the great vessels.

*Illustrative Cases.*—In one case a considerable quantity of pus was removed from the right side by aspiration at the time of the operation on the left side. The right side was operated upon four days later, by which time sufficient adhesions had formed to prevent collapse of the lungs. The patient, a boy of two years, made an excellent recovery.

The second patient was one year of age. Pus had been present in both sides for a considerable time. The left thoracic cavity was opened first. The sac on the right side was smaller than that on the left, and was operated on by incision three days later. The child was very much reduced by the protracted illness. In spite of the free daily irrigation of both cavities the typical temperature persisted, probably on account of the very extensive suppurating surfaces. The child died from exhaustion twelve days after the second operation.

**Empyema Necessitatis.**—Spontaneous rupture of the pleural sac may occur in cases of empyema of considerable duration which are not promptly diagnosed or not operated upon if diagnosed. Cases of this nature have been reported in which the pus ruptured into the esophagus, into the bronchi, or through the diaphragm into the peritoneal cavity.

*Illustrative Cases.*—*Case 1.*—In the case of a well-nourished boy three years of age the pus had been sacculated over the anterior portion of the left lung. The parents, not particularly intelligent people, objected to operation, and while it was under consideration by them, two or three days after the diagnosis was made, the pus ruptured into the bronchi and was discharged from the mouth in large quantities during a coughing paroxysm. The child made an uninterrupted recovery.

*Case 2.*—Another patient, a boy of two years, came under observation for a soft fluctuating swelling, the size of a small orange, on the right side, immediately below the nipple. Exploration with a hypodermic needle showed pus. An incision was made and about 3 ounces of pus were evacuated. When the sac was emptied it was found to communicate with the right pleural cavity by an opening between the seventh and eighth ribs. The wound was dressed and the child recovered without further complications.

## PULMONARY GANGRENE

Pulmonary gangrene is a very rare complication of pneumonia. Three cases observed by the writer all developed during the course of a bronchopneumonia. The gangrene is supposed to be due to an embolism of some branch of the pulmonary artery or to a septic thrombosis. The odor

of the breath is most characteristically offensive and actually beggars description. As a complication of pneumonia pulmonary gangrene is invariably fatal.

Except for the odor of the breath there are no significant symptoms which may not exist with the usual attack of bronchopneumonia.

### PULMONARY ABSCESS

Pulmonary abscess, except in the form represented by small foci which may exist in bronchopneumonia and are not recognizable clinically, is a very unusual complication of pneumonia. Comparatively few cases are diagnosed, because of the occurrence of the abscess with empyema or because symptoms resembling empyema are present. The abscess is usually discovered during exploration for pus in the pleural cavity or at the time of operation for empyema. *x*-Ray may reveal the condition.

Lung abscess may occur as a sequel to tonsillectomy. Whether this occurrence is to be ascribed to aspiration of septic material during operation or to metastasis of bacterial emboli through open blood channels is a moot question. As a rule, any form of insufflation anesthesia is contraindicated in tonsil operations. (See p. 381).

*Illustrative Case.*—A child had pneumonia of the right upper lobe, which failed to resolve after abatement of the urgent symptoms. The temperature continued at 101° to 102° F., and there was a distressing cough. For this a mixture was given containing full doses of syrup of ipecac and ammonium chlorid. This was given repeatedly without dilution, against instructions, and produced violent emesis. During a vomiting seizure the child brought up a considerable amount of pus, after which the recovery was prompt. Evidently the straining had produced a rupture of a pulmonary abscess into one of the larger bronchi.

### PULMONARY TUBERCULOSIS

Infection of the lungs with the tubercle bacillus constitutes the chief type of tuberculosis in the human. The lungs are the most active seat of the process in at least 90 per cent. of the cases.

**Pathology.**—In the most acute form of pulmonary tuberculosis the lungs contain gray, translucent tubercles in varying numbers. These may be only few in number, or may be very closely studded throughout both lungs. The lesions may also be present on both surfaces of the pleura. Acute bronchopneumonia, with or without fibrinous pleurisy, is a frequent complication. In a late stage the tubercles undergo cheesy degeneration and are yellow in color. The coalescence of neighboring tubercles may give rise to cheesy masses, which eventually undergo softening. The tubercles are more often peribronchial than perivascular in distribution. Owing to the more direct course of the right main bronchus, the right lung is often involved before the left.

Caseous degeneration of an area of pneumonic exudate may occur, and the resulting cheesy pneumonia frequently leads to softening and cavity formation. These cavities may occur in any part of the lung, but are most common in the right middle and upper lobes, and usually communicate with a bronchus. Their walls are irregular and grayish in color, are often crossed by blood-vessels, and contain caseous necrotic material.

The connective tissue of the lung is increased in cases of pulmonary tuberculosis which have undergone repeated attacks of pneumonia, or which follow empyema of long standing. In such cases the pleura also is thickened and may be covered with an organized exudate.

Phthisis as it is seen in the lungs of adult subjects is seldom met with in children under eight or ten years of age.

The bronchial lymph-nodes in cases of pulmonary tuberculosis are involved in the tuberculous inflammation in about 97 per cent. of the cases. The nodes are enlarged, and on section show all stages of tuberculosis, from discrete tubercles with small cheesy centers to cheesy degeneration of the entire node. Softening or suppuration is very common, while calcareous degeneration of a tuberculous focus in a lymph-node is infrequently seen in infants, but is less rare in children over two years of age. The bronchial and mediastinal lymph-nodes may be so much enlarged as to afford dulness on percussion and occasion respiratory difficulty from pressure.

**Symptoms.**—In infants and very young children there is no characteristic symptomatology. This seems strange in a disease of such gravity. Even in the miliary type, where we have been taught to expect high temperature, rapid respiration, and other severe toxic symptoms, such symptoms do not always exist. The signs correspond to those of bronchopneumonia—fever,  $101^{\circ}$  to  $104^{\circ}$  F., rapidity of respiration, cough, and the chest signs peculiar to catarrhal pneumonia. There may be only cough and the evidence of a generalized bronchitis. The temperature range is not characteristic, and may not differ from that of bronchopneumonia.

A suspicious symptom in an infant is steady emaciation out of proportion to the other positive evidences of disease. The child takes food well, sleeps well, and is comfortable. There may be a slight elevation of the temperature or no elevation throughout the illness—in fact, the temperature may run a subnormal course. The picture is that of marasmus.

In older children after the third year the disease manifests itself by more distinct signs, such as emaciation, loss of appetite, fatigue on slight exertion, and perhaps night-sweats. There is, moreover, a troublesome dry cough with little expectoration. Elevation of temperature in older children is almost an invariable symptom. It may not be high, however, perhaps not above  $101^{\circ}$  F. in the evening. The child complains of chilliness and soon shows signs of anemia. Pain is unusual and hemoptysis rarely occurs.

In the miliary type in older children the symptoms are also active, particularly the temperature, which will range very high— $103^{\circ}$  to  $105^{\circ}$  F.—or it may be low in the morning and high at night. The respiration and the pulse are rapid. Cough is not a prominent symptom. There is rapid loss in weight.

It will be observed that the symptoms may aid us but little. The x-ray is of great value, but leaves opportunity for misinterpretation in differentiating such conditions as fibrosis and non-tuberculous bronchopneumonia from actual tuberculosis of the lung.

**Diagnosis.**—For the positive diagnosis of tuberculosis in children

the presence of the tubercle bacilli must be proved. The examination of the lungs, except by showing the existence of a cavity, aids us but little, for, in the miliary type, there may be tuberculosis without chest signs. The various lung changes evident on examination may differ in no way from those which may be found in acute or chronic bronchopneumonia. Accompanying tuberculosis, moreover, there may be a bronchial catarrh, which in no way differs in its manifestations from that of simple generalized bronchitis.

A positive *intradermal tuberculin test* (p. 825) is strong corroborative evidence of tuberculosis in young infants. The presence of fine crepitant râles localized over the right middle lobe (front) often means a localized tuberculous process, the bacilli being conveyed by the lymphatic channels extending from the bronchial glands to the spaces between the middle and upper lobes. The value of this sign has been proved in a large number of cases. In the case of older children the tuberculin test, while positive, may be misleading, as the tuberculosis may be latent or entirely healed, and have no bearing on the immediate illness.

*x-Ray diagnosis* of tuberculosis in children is invaluable, but calls for interpretation based on large experience. Mediastinal adenopathy and peribronchial infiltration indicated by fan-shaped shadows radiating from the root of the lung may be easily detected, but do not always spell "tuberculosis." Repeated examinations are essential.

The *D'Espine sign*, while of value, is only an aid (see p. 810).

After the fourth or fifth year the diagnosis is seldom beset with the difficulties encountered in infancy. At the later period of life localized signs of bronchitis, or partial or complete consolidation with dulness, may be manifest. Further, children at this age expectorate, so that collection of the sputum is easily accomplished.

*Methods of Obtaining Sputum.*—In dealing with infants who do not expectorate a satisfactory method of obtaining the bronchial secretion is to pass a sterile catheter into the child's larynx. This excites coughing so that the secretion is brought up through the larynx and adheres to the tube.

Another method which may be used consists in irritating the pharynx with a small piece of sterile gauze grasped in an artery clamp. As a result of the coughing thus induced the secretion from the trachea will be deposited on the gauze. Several tests may be necessary before the bacilli are discovered.

*Bacilli in the Stool.*—To search for bacilli in the stool is not a very satisfactory procedure, and is not necessary, in view of the success attending the above methods of securing material for examination. In suspicious cases in which the sputum examination fails to reveal the bacillus the stools should be examined.

**Prognosis.**—The prognosis for infants is very unfavorable. Nevertheless in infants healed tubercular foci are occasionally found at autopsy. A child eighteen months of age who died of diphtheria had a large encysted calcareous tubercular nodule in the left lung, 1 inch by  $1\frac{1}{2}$  inches in size. Likewise the bronchial glands may show evidences of previous disease. In view of the large percentage of positive reactions to the von Pirquet skin test in children past ten years of age it would seem that there are

many more cured cases in children than has heretofore been appreciated. After the fifth year, if the case is seen reasonably early, if the child has a fair resistance, and if the management can be suitably carried out, the prognosis is very good indeed. The prognosis is further favorable if the infection is primary. If there is a lighting up of an old tubercular lesion in the bronchial glands or elsewhere the prognosis is much less favorable. Recoveries in New York City have been frequent in primary cases of children who could not be sent away.

**Associated Lesions.**—The invasion of the tubercle bacillus usually means the involvement of more than one organ or portion of the body.

*The Liver.*—An autopsy in a case of pulmonary tuberculosis will very frequently show, in addition to the evidences of the disease in the lung and pleura, that the liver is involved to the extent of showing a generous distribution of tubercles in its surface and in the liver substance.

*The Spleen.*—It is rare, in making a postmortem examination in pulmonary tuberculosis, not to find the spleen the seat of the disease. Both the surface and the splenic tissue may be filled with tubercular deposits.

*The Heart.*—Tuberculosis of the heart muscle is very unusual. A few cases have been reported. The pericardium is occasionally the seat of a few tubercles. They are usually found when there is an extensive general tuberculosis.

*Stomach.*—Tuberculosis of the stomach is of very rare occurrence. Hale reported having seen but 5 cases in his large autopsy experience.

*Intestines.*—Infection of the intestinal mucosa without further abdominal involvement is occasionally seen at autopsy.

The *kidney* is very frequently the seat of tuberculosis. About 25 per cent. of the writer's cases have shown such lesions. They are usually of the miliary type, scattered over the surface, with a few in the kidney substance.

Tuberculosis of the *larynx* in children is of very unusual occurrence. Demme reported a case in a child four and one-half years old (Koplik).

The *pancreas*, *thymus gland*, and *peritoneum* are rarely at autopsy found to be the seat of a few miliary tubercles.

Tuberculosis of the *cervical lymph-glands*, *brain*, *mesenteric glands*, *peritoneum*, and *abdomen* will be discussed in separate chapters.

**Treatment.**—*Climate.*—For those who are so situated financially as to have the advantages of an equable climate, a change of residence or sanitarium treatment should be provided. A dry climate of equable temperature that will allow the tuberculous child to spend the greatest number of hours in the open air is best. The climate of southern New Mexico and Arizona is exceptional for these cases. Children do well in the Adirondacks and in Sullivan County, New York, but the severity of the winter makes these localities less desirable.

*Diet.*—Equally important, if not more so than climate, is the nutrition of the patient. This must be raised to the highest possible standard, but there should be no overfeeding, such procedure being of no value in any disease in the young. A liberal protein diet of milk, meat and eggs, oatmeal, and the legumes—dried peas, beans, and lentils,

which are given in the form of a purée, is to be recommended. It is not wise to insist that a definite amount of food be given in twenty-four hours. The mother or nurse is to be told, however, that these foods, prepared in different ways so that the child will not tire of them, are to form a considerable part of the diet. Green vegetables and fruits should be given because of their salt and vitamin content. When three meals a day are given, with, perhaps, a glass of milk in the middle of the afternoon, better nutrition may be maintained than with more frequent feedings which often defeat their own purpose by producing disgust for, or intolerance of, food. The child should be fed on nutritious food, for which an appetite must be developed; for, inasmuch as recovery is dependent largely upon nutrition, the question of appetite and food capacity is of paramount importance. Candy, sweet crackers, and other harmful articles should not be allowed. In order to satisfy the candy craving a small quantity of sweet chocolate may be given after the noon-day meal. The best appetizers are reasonable exercise, entertainment and play that do not fatigue, and fresh air in abundance. Upon our ability to meet these requirements depends, to a large degree, the outcome of the case.

The majority of the children with pulmonary tuberculosis cannot be sent to sanitariums or to health resorts, but must be treated in their homes. This is accomplished successfully in New York City even among the tenement population. The basic principles of management comprise a properly directed life, good food, and fresh air. These are the weapons for fighting the enemy, regardless of whether the residence is among the rich or poor, in town or in country. It is, however, among the tenement population that we experience the greatest difficulty. To tell these people how the child is to be fed is not enough. The feeding as directed entails considerable expense, which the parents may not be able to meet. If after personal investigation (which should be made in every case) it is demonstrated that proper nutrition or suitable clothing is impossible, the writer has often explained the situation to some charitably inclined person of means, and has yet to know of an instance in which clothing and a small but sufficient weekly food allowance were not forthcoming. An allowance of 25 cents a day for fresh meat and milk has often furnished what was required to bring the case to a favorable termination. The uselessness of much of our medical advice to the poor would, on slight reflection or a little investigation, be apparent. Directions are too often given for the care of the sick which are absolutely impossible of fulfilment.

*Hygiene.*—In addition to the diet above outlined, the advantages of an outdoor life, and the means by which fresh air may be obtained all the year round, should be fully explained. Any simple direction as to what may appear to be a radical procedure is rarely carried out without a rational explanation of its necessity. During the daytime the child should be kept outdoors. Close, tightly sealed sleeping apartments at night, however, will undo the good of the outdoor life during the day. The mother should be told to have the child sleep alone in the largest room of the apartment, and always in a room in which the windows are opened. This is usually possible. A sponge-bath or tub-bath should be given at bedtime, followed by brisk rubbing with a towel.

If there is much emaciation, an olive-oil or goose-oil inunction should follow the salt bath.

Sometimes these directions are followed implicitly; at other times they are forgotten. It is astonishing, however, what rapid improvement will follow when a tuberculous child of the tenements is given the benefit of fresh air, day and night, with suitable food and cleanliness, even though the conditions are those of a great city. Among the more fortunate classes the same method of treatment, of course, with a more satisfactory application, is to be carried out. Among the well-to-do, however, we see fewer cases.

*Tonics.*—The usefulness of drugs depends to a large degree upon an increase of food capacity which their use may cause. Any of the prescriptions written below may be used alternately with cod-liver oil and malt, each being given for five days. For a child from seven to twelve years of age the following are useful restoratives and appetizers:

- |    |  |               |
|----|--|---------------|
| R. | Tincturæ nucis vomicæ . . . . .                              | gtt. xlviii   |
|    | Saccharini . . . . .   | gr. iss       |
|    | Aquæ . . . . .   | q. s. ad. ʒiv |
| M. | Sig.—One teaspoonful every two hours. (Six doses daily.)     |               |
| R. | Ferri et quiniæ citratis . . . . .                           | gr. xlviii    |
|    | Vini xerici . . . . .  | ʒiv           |
| M. | Sig.—One teaspoonful in water three times a day after meals. |               |
| R. | Tincturæ nucis vomicæ . . . . .                              | gtt. lxxv     |
|    | Extracti ferri pomati . . . . .                              | gr. vj        |
|    | Quiniæ bisulphatis . . . . .                                 | ʒj            |
| M. | ft. capsulæ no. xxx.   |               |
|    | Sig.—One after each meal.                                    |               |

If night-sweats occur, from 1/200 to 1/160 grain of atropin at bedtime will often furnish relief.

*Care of the Sputum.*—Various devices for collecting the sputum may be obtained in the shops. A cheap and effective method is the use of a Japanese handkerchief or paper cup which, when used, is at once placed in a paper bag, the bag and its contents being burned at the close of the day. The dangers of infecting others should be fully explained to those in charge of the patient, kissing and fondling being forbidden.

# HELIO THERAPY

Heliotherapy, or the treatment of bodily ills by exposure to the sun's rays, has been utilized for curative purposes many centuries. In the Swiss Alps Rollier and Bernhard were the first to take up heliotherapy in a scientific manner for the definite end of curing tuberculosis. The method is very simple and consists in exposing the body to the direct rays of the sun for a given time. Most satisfactory results are reported by the above authors, particularly in cases of surgical or bone tuberculosis.

This method of treatment of tuberculosis as carried on by Dr. Gerald Webb of Colorado Springs is described as follows: "Children can be exposed naked at an altitude of 4000 to 5000 feet when snow is on the ground because the temperature in the sun may be as high as 90° or even 120° F. Patients arriving at this altitude are first allowed to become acclimated

by rest indoors for a few days. Then they are placed on verandas with a white garment covering the body."

"Exposures to the sunlight are made very cautiously and gradually, fixed rules being followed no matter what part of the body may be affected with tuberculosis. On the first day the feet are exposed three or four times at hourly intervals for five minutes each time."

"On the second day the bare legs to the knees are exposed in a similar manner, and the feet are exposed three times for ten minutes each. On the third day these exposures are increased by five minutes, three times daily, and on the fourth day the thighs are included. On the fifth day the abdomen and chest respectively are exposed. The pulse and temperature variations are used in guiding the treatment, and for certain individuals variations in the sun treatment are made. By this method in summer or winter patients can remain from four to six hours bathing in the sun."

"Naturally, other surgical methods are not neglected. Splints, braces, and the like are employed when necessary to limit motion in diseased joints. The appliances are made as light and as open as possible. Open wounds when not being sunned are dressed with gauze soaked in alcohol. Such "open" cases are found more refractory to the treatment than "closed" cases."

"Certain blood changes have been noted, such as an increase in the phosphorus content and the number of the red blood-corpuscles. Some observers, too, have claimed that the lymphocyte blood-cells—known to be antagonistic to the tubercle bacillus—are increased by heliotherapy."

"We feel it wise to warn patients against the careless employment of sun baths without proper medical control, as harm can be done by them. The head should be protected, especially at first, by a light hat, and in the case of adults Rollier sometimes advises the covering of the heart with a wet compress."<sup>1</sup>

The range of application of heliotherapy is being rapidly extended as its influence on phosphorus and calcium metabolism in rickets is being better appreciated, and the value of the method in the treatment of tuberculosis is now indubitably established. (See p. 764.)

<sup>1</sup> Jour. of Outdoor Life, September, 1915.

## XII. DISEASES OF THE HEART

### DIAGNOSIS IN DISEASES OF THE HEART

**Auscultation.**—In the diagnosis of the different cardiac lesions in children auscultation is by far the most useful means at our command, and for this reason may receive foremost consideration. For adults the physician employs auscultation, either with the unaided ear or with the stethoscope, at the following chest areas:

The aortic area.

The pulmonary area.

The tricuspid area.

The mitral area.

In children tricuspid disease is of most infrequent occurrence. The pulmonary valves are involved only in congenital heart disease. In the routine examination for heart lesions in children the findings are simplified by the fact that aortic and mitral valve lesions are those encountered in an immense majority of the cases.

Owing to the difference in the position of the heart of the child as compared with that of the adult, the various sound areas also differ, and they vary at the different periods of childhood in accordance with the changing position of the heart.

Before the sixth year the mitral area corresponds with the apex-beat at a point in the nipple-line, or not more than  $\frac{1}{4}$  inch without the nipple-line, in the fourth interspace.

The aortic area is slightly to the right of the sternum in older children; in the very young, over the sternum or at its immediate right border at the level of the second or third interspace, varying with the age of the child.

The pulmonic area is on the same plane at the left border of the sternum.

At the end of the sternum, slightly to the left, is the tricuspid area.

It is by no means claimed that sound areas indicate the position of the valves, but we know, from combined clinical and autopsy findings in children, that murmurs indicating lesions of the respective valves are best heard at these areas.

*The Normal Sounds.*—The normal heart sounds are not easily described. The normal cardiac cycle is made up of the *first* and *second heart sounds*. Listening at the apex or slightly above, one hears at the time of the impulse the low-pitched, dull *first sound*, followed by the so-called *second sound*, which is short and higher pitched, and is supposed to be due to closure of the semilunar valves.

There is much divergence of opinion as to the cause of the first sound. Most diagnosticians believe that it is due to the contraction of the heart muscle associated with the sudden closure of the mitral valves.

The heart sounds vary considerably, depending upon the age of the patient; thus, in the infant both sounds are short and high pitched, and

the muscle sounds which appear later in life, while present, are not prominent.

There is rarely difficulty in differentiating the two sounds in the young. The second sound is heard loudest over the base of the heart at points corresponding more or less closely to the pulmonic and aortic areas. In the event of difficulty in differentiation, the first sound should be sought at the apex. On gradually moving the stethoscope upward, the first sound will gradually become fainter, and as the base of the heart is approached the second sound will be heard much more distinctly and loudest in the areas referred to.

The points of maximum intensity and areas of transmission of heart sounds in children cannot be arbitrarily laid down. In a general way the landmarks can be indicated, and in most instances will stand.

In diagnosing cardiac disease in children we have to consider the age of the patient with particular reference to the size and position of the heart, whether the chest wall is thin and muscular, or fat, and whether the child is crying or quiet. All cardiac sounds in the young are proportionately much louder than in adults. In delicate children the sounds vary greatly from those heard in the strong and robust. A first sound, characterized by a muffling or absence of clearness, is very frequently heard in delicate children. After an illness in a strong child this peculiar quality is very apparent, and is without doubt due to muscular insufficiency induced by degenerative changes which in most cases are temporary in character.

The changed first sound is often interpreted and treated as an evidence of endocarditis. In heart failure in serious diseases the muscle element of the first sound gradually disappears so that this sound becomes short and snappy in quality, due to a degeneration of the heart muscle. The weak muscle sound tends to exaggerate the sound produced by the valve closure.

The second sound is caused by the closure of the semilunar valves, and as there are two sets of these valves, the aortic and pulmonary, the aortic second sound in older children is heard in the aortic area, and the pulmonic second sound in the pulmonary area.

In babies and very young children a differentiation of the aortic and pulmonic second sounds is unquestionably difficult. The second sound is always accentuated in conditions in which the cardiac vigor is temporarily or permanently impaired, as in myocarditis with hypertrophy and dilatation of the left ventricle.

**Inspection** alone is of little value in cardiac examination. One learns nothing by inspection that may not be discovered through palpation, percussion, and auscultation. In acute cardiac disease in which there is often a decided overaction of the heart, a decided undulating movement of the entire left chest anteriorly will be observed. This usually occurs when there is much dilatation or hypertrophy of the left ventricle.

Inspection may reveal a retraction of the chest wall at the apex between the fourth and fifth interspaces. This closing in is due to adhesions (the result of a former pericarditis) between the heart, the pericardium, and the chest wall.

**Palpation** is useful in determining the position of the apex-beat, in judging of the force of the cardiac impulse, and in the detection of a thrill. The pericardial friction-rub and the heart rhythm may likewise be determined in this way.

**Percussion.**—For this examination the upright position is desirable. Percussion is chiefly of value in determining the size of the heart. Hypertrophy or dilatation of both the right and left heart may be fairly accurately determined. This method is also of value in determining the amount of fluid in the pericardial sac.

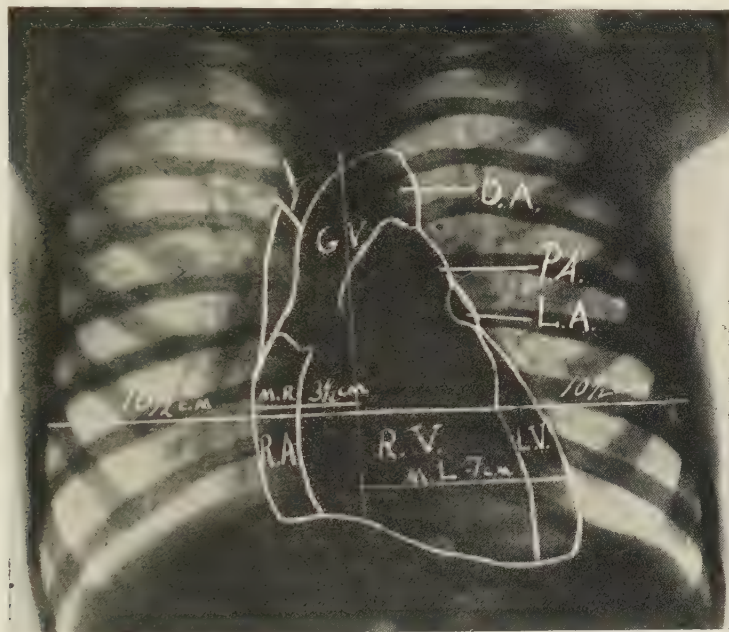


Fig. 77.—Diagram, over a normal heart, child nine years, taken at 6 feet distance. R.A., Right auricle; R.V., right ventricle; L.V., left ventricle; L.A., left auricle; P.A., pulmonary artery; D.A., descending aorta; G.V., great vessels; M.R., middle right diameter; M.L., middle left diameter of the heart; M.R., 3.5 cm. + M.L., 7 cm. = 10.5 cm. which is one-half the diameter of the chest. (Courtesy of Dr. Charles Winfield Perkins.)

The normal right limit of absolute dulness for the heart may be taken as the right sternal border. The midsternal line supplies the boundary for relative dulness. The left limit of dulness corresponds to a perpendicular line drawn slightly without the apex-beat.

The area of dulness will vary considerably in health. The younger the child, the further to the left will be located the border of cardiac dulness. This limit is best determined by percussing from a point in the anterior axillary line toward the right, in the fourth interspace.

The maximum transverse diameter of the heart normally in a radiograph does not exceed half the transverse diameter of the chest at the same level. The heart may be said to be abnormally large when this proportion

is not maintained. The normal relationship of the heart to the chest is depicted in detail in Fig. 77.<sup>1</sup>

### HEART MURMURS

There are two gross divisions of heart murmurs: *Organic* or *valvular*, *inorganic* or *functional*.

**Organic murmurs** are the result of a change in the heart structure due to a congenital malformation or to deformities resulting from diseased processes which produce a thickening, contraction, shortening, or narrowing of the valves involved.

An enlargement of the orifice (*e. g.*, the mitral or aortic orifice) may also cause a murmur due to the resulting incomplete closure of the valves.

*Regurgitant Murmur.*—When the valves fail to close, a murmur is caused by the regurgitation of the blood back through the opening. If the valves are roughened, the intensity of the murmur is the greater.

*Stenotic Murmur.*—When the blood is impeded in its passage through the heart as a result of a narrowing of the opening or roughening of the valves, a murmur of stenosis is the outcome.

Organic heart murmurs are classified as follows, depending upon the time of their occurrence in the cardiac cycle:

Systolic.

Diastolic.

Presystolic.

From the association of the murmur with one or another of the different phases of the cardiac cycle we determine the location and nature of the lesion at hand.

*Location of Lesions.*—In examination of the heart in order to locate a lesion by the murmur we must determine when it occurs in the cardiac cycle, its point of maximum intensity, and its area of diffusion.

In children acquired valvular lesions will almost invariably be found to involve the left heart, the mitral valves being by far the most liable to disease.

Mitral insufficiency takes first place in the order of frequency of valvular lesions. Mitral stenosis is evidently present in about 10 per cent. of the cases of insufficiency. Lesions of the aortic valves are, fortunately, much rarer. The ratio of mitral to aortic disease is about 15 to 1.

TABLE DEMONSTRATING LOCATION AND CHARACTER OF LESIONS BASED UPON THE ADVENTITIOUS HEART SOUNDS OR MURMURS

Systolic.	Diastolic.	Presystolic.
Mitral regurgitation.	Aortic regurgitation.	Mitral stenosis.
Tricuspid regurgitation.	Pulmonary regurgitation.	Pulmonary stenosis.
Pulmonary stenosis.		
Aortic stenosis.		

Pulmonary stenosis occurs only as the result of congenital lesions, and tricuspid lesions in children are only observed very late in severe cardiac disease, as a result or accompaniment of right heart failure. In the absence of these etiologic conditions a systolic murmur in a child

<sup>1</sup>Hartshorn and Perkins: *x-Ray Studies of Cardiac Diseases in Children*, New York Med. Jour. and Med. Record, March 7, 1923.

must, therefore, be attributed to mitral regurgitation or aortic stenosis. Moreover, for the reasons explained, a diastolic murmur means aortic regurgitation, and a presystolic murmur, mitral stenosis.

*Acquired lesions* in children will, therefore, permit of the following grouping:

Systolic.	Diastolic.	Presystolic.
Mitral regurgitation.	Aortic regurgitation.	Mitral stenosis.
Aortic stenosis.		

Keeping the time of the murmur in mind, we thus have a means of readily locating the lesions.

*Mitral regurgitation* is due to shortening or adhesions of the mitral valves sufficient to prevent proper closure of the leaflets. The valvular defects are the result of a previous acute or chronic endocarditis. The murmur of mitral regurgitation is heard loudest in the apex region, over the so-called mitral area. In children, because of the thin chest wall, this murmur has a wide transmission. The particular line of transmission is upward and to the left toward the axilla, and to the back, the sound here being loudest at the angle of the scapula and between the scapula and the vertebræ.

*Mitral stenosis* (producing a presystolic murmur) is due to a narrowing of the mitral orifice as the result of adhesions which bind the valves together, and produce, in some instances, the so-called funnel or button-hole opening. The murmur is heard loudest slightly above and to the right of the apex-beat, in point of time preceding the systolic or first sound of the heart. Not infrequently this murmur merges into that produced by the mitral regurgitation, completely replacing the first sound of the heart. The area of diffusion is quite circumscribed.

Mitral lesions which have existed for some time always give rise to compensatory hypertrophy, with corresponding displacement of the apex-beat to the left. This may readily be determined by palpation and percussion, showing the degree of cardiac enlargement.

As a result of the contracted orifice or the roughened valve surfaces, vibrations are produced in the blood-stream which, when transmitted to the chest surface, produce a corresponding peculiar effect upon the palpating finger or hand of the examiner. This sign is known as a *thrill*.

It must be carefully differentiated from the sensation communicated in some subjects by the thrust of a normal heart against a thin chest wall.

*Aortic stenosis* produces a systolic murmur which is heard loudest over the sternum and the second left costal interspace; not over the second right interspace or to the right of the sternum, as in the case of adults. The murmur, which is usually harsh and grating in character, is widely transmitted in a lateral direction and also into the carotids of the neck. Autopsy usually shows the existence of adhesions between the semilunar valves.

In comparatively few cases a thrill may be felt over the upper portion of the chest and the carotids.

*Illustrative Case.*—In a girl patient eight years of age in whose heart stenosis and regurgitation were combined there was a most exceptional thrill over the dilated arch of the aorta and the carotids.

In *aortic regurgitation* the murmur is diastolic in time, and is heard not to the right of the sternum, but sharply against the left border, or over the extreme left of the sternum, on a level with the fourth costal cartilage. This murmur is usually associated with the obstructive murmur, and is due to a failure of the deformed valves to close. The area of diffusion is wide. There is always displacement of the apex-beat to the left. It is the condition of aortic regurgitation, pre-eminently, that causes visible pulsation of the carotids.

In the child already referred to the throbbing was so pronounced that not only was the head and body shaken, but the mother, who slept with the patient, was kept awake by the vibration of the bed.

In typical cases auscultation may detect a pistol shot sound if the stethoscope is placed over the bifurcation of the brachial artery or over the deep palmar arch, and inspection may reveal capillary pulsation beneath the nails.

**Functional murmurs** are most frequently encountered between the third and twelfth years and are not at all unusual in rapidly growing children of both sexes. The functional murmur in infants or very young children is not infrequently associated with anemia. This is not invariably the case, however, for a non-organic murmur at this age may be the result of a very severe illness or whooping-cough, causing a temporary dilatation.

The functional murmur is systolic in time, and is heard loudest at or slightly above the apex, with a uniform, circumscribed area of diffusion which extends for only a few inches in any direction. In character the murmur is soft and blowing. It is not heard at the back. There is no associated hypertrophy or dilatation of the heart nor evidence of any stasis or dropsy. There is no accentuation of the second sound. The presence of a functional diastolic murmur in a child is practically unknown.

*Special Types of Functional Murmurs.*—**Venous Murmurs:** In anemia the normal venous murmur heard over the great vessels above the clavicle and posterior to the sternocleidomastoid muscle is intensified and exceeds its normal physiologic limits. The murmur is constant, although it may be accentuated when the patient stands with head inclined to the opposite side. The venous murmur is to be distinguished from the arterial murmur by the fact that the former is continuous and not synchronous with the heart-beat.

**Cardiorespiratory Murmur:** This murmur deserves particular mention for the reason that it has a distinct entity. It may be heard in those cases in which the margin of the lung covers the heart. The murmur is usually systolic. It is heard best when the patient is standing and leaning forward, and at the end of inspiration is usually loudest. This murmur has no clinical significance, and is of interest only because it may be confused with other murmurs, functional or organic.

**Murmur During Development:** As already noted, a functional murmur is not at all unusual in rapidly growing children.

**After Acute Illness:** Inasmuch as the functional murmur which occasionally occurs with, and disappears after, an acute illness is in all respects similar to those that exist for several years and are later outgrown, it may be fair to assume that, in both instances, the same cause

is operative, and that this factor, in all probability, is a moderate regurgitation, due perhaps to a dilatation of the mitral orifice preventing proper closure of the valves, a condition temporary in both types of cases, but in the one of longer duration than in the other.

*Etiology.*—Although anemia probably constitutes the most frequent cause, yet functional murmurs are heard in apparently normal children, existing for a period of years and then disappearing. A temporary murmur will often be heard in boys after violent exercises or games of competition in which a great deal of physical work is involved. In girls the murmur may also result from excessive bicycle riding or prolonged rope jumping. In the spring of the year, after hard work at school, many girls, under careful examination, will show a slight systolic murmur. In our opinion many of these cases are due to a *dilatation* of the left heart, producing a wider auriculoventricular orifice than the valves can completely close, with the result that there is a moderate amount of leakage. This, in time, is corrected as the heart muscle regains its normal condition.

*Differential Diagnosis.*—The chief point of aid in differentiating all murmurs, whether functional, acquired, or congenital, is the fact that in congenital and acquired heart disease there is a distinct lesion, and the murmur, as can be readily understood, is, therefore, constant. When, however, the murmur is due to causes related to muscular action or blood conditions, variations in posture or changes in the heart action dependent upon work will produce either a modification of the murmur or its complete disappearance. Even during a single examination a murmur of this nature may not always be the same.

*Illustrative Case.*—A boy patient, aged six years, had a soft, blowing systolic murmur, which presented varying degrees of intensity, depending upon whether he was lying down or sitting up or whether he was quiet or exercising. The murmur appeared when he was two years old. He was always the picture of health. The murmur gradually became less each year, giving promise that when he was ten years old it would probably cease to exist. An older sister gave evidence of exactly the same condition, the murmur in her case disappearing at about the ninth or tenth year. The murmurs in these children were not anemic nor cardiorespiratory.

*Treatment.*—The functional murmur requires no treatment. But the condition causing the murmur may require attention and determine treatment.

## FUNCTIONAL ABNORMALITIES IN CARDIAC RATE AND RHYTHM

In addition to functional murmurs there are functional departures from the normal in cardiac dynamics. An outstanding example of the disorders of this type is afforded by the condition known as *tachycardia*, in which the heart action independently of the usual causes of increased rate is persistently very rapid. *Bradycardia*, or excessive slowness of the heart action, is less commonly encountered.

The ordinary child, more or less highly emotional, rapidly growing, and subject to stress of varying nature, finds a ready reaction in the heart muscle and its nerve supply.

The advent of puberty in both sexes is often suggested by the presence

of *cardiac arrhythmia*. The existence of this condition is ordinarily discovered incidental to the examination of the chest for other possible disorders, as the patient is usually unaware of irregularity in the heart action.

Tachycardia may be a manifestation of thyroid dysfunction. Such cases are usually those of hyperthyroidism, sometimes called goiter whose heart rate ranges from 120 to 140 during ordinary rest and is not readily lowered during sleep. The heart is well developed, hypertrophied as an organ that is active. Under appropriate treatment and change the action returns to normal. The slight enlargement of the thyroid so common in girls at puberty gives rise in many of the cases of the type cited to the diagnosis of goiter. Such cases rarely go on to be confused with those of Graves' disease. Although the clinical picture may not be perfectly those of hyperthyroidism, proof on this point is lacking. The fact remains that in connection with a vast amount of clinical material in private practice and hospital and consultation work, the senior author has seen but 2 cases of actual Graves' disease in children under fifteen years of age.

*Illustrative Cases.*—*Case 1.*—A girl who came under observation for rapid heart action when four years old has had tachycardia for twelve years. During her life she has been entirely well and in some of her usual activities at least 140 beats per minute. At five and six years of age she was treated without benefit. At the age of ten years the parents were under the care of a pediatrician who gave good treatment for several months, but without response. She was then referred to a heart specialist, who made an electrocardiographic examination and reported sinus arrhythmia, but stated that the heart in other respects was normal. He offered no suggestions other than those that had already failed. Different physicians, later consulted, were unable to achieve results, and the parents of the child, at length tired of the restriction of her activity, discontinued all treatment. For the past seven or eight years the girl has led the life of the ordinary well-bred child, taking her regular baths, going bathing, and playing the usual children's games, with a pulse-rate ranging from 140. She is the owner of the basket of the best pony and she has been given as thorough a course of medical training as treatment that we could find to give the parent for the care of a child.

*Case 2.*—Paroxysmal tachycardia in a boy eight years of age was marked by seizures suddenly occurring, or frequent attacks, stopping the use of milk for that period. The heart suggested greatly hypertrophied and the general picture was suggestive of a large amount of it. Treatment given for this condition was followed by cessation of the arrhythmia.

Paroxysmal tachycardia in children has almost always been associated with a congenital lesion.

*Illustrative Case.*—A boy patient never revealed a heart action over 40 during observations covering the period from birth till the fourth year, at which time he passed from observation. At that time an electrocardiographic examination was suggested and refused.

*Heart-block* occurs occasionally in childhood as a result of conditions interfering with the normal conductivity of the fibers of the bundle of His, notable in the case of myocardial weakness or sudden degeneration after infection. Heart-block is also observed as one of the signs of myocardial degeneration and may occur even after acting of other drugs than digitalis. The digitalis effect may be temporarily benefited and is transient if the administration of drug is promptly stopped.

*Fainting attacks* are of frequent occurrence as a result of nervous disorder and may occur independently of cardiac weakness.

*Auricular fibrillation* is rarely noted in children.

The study of cardiac disease has been greatly enhanced during the past two decades by the development of electrocardiography. To this science Lewis, Mackenzie, Einthoven, and Williams have contributed most extensively.

Under conditions that suggest cardiac disease or derangement it is our duty to exclude the existence of organic cardiac disease, and when this has been done it is equally our duty to find defects apart from the heart that may account for the altered function, and then leave the organ to take care of itself. This in the great majority of cases it will do.

### CONGENITAL HEART DISEASE

In congenital heart disease there is a fundamental structural fault. The heart in one or more respects is anatomically imperfect.

**Etiology.**—Many cases are directly traceable to defective development in the embryonic cardiovascular system, and to understand well the anomalies found at autopsy one must review the subject of the fetal circulation. Septal defects in the heart and persistence of the patent ductus arteriosus and various forms of hypoplasia of the great vessels illustrate the lack of normal completion in cardiovascular development. Other abnormalities are ascribed to a fetal endocarditis. Constitutional disease in one or both parents may be a causative factor producing the endocarditis. The frequent association of congenital heart defects with other defects in development is noteworthy, and particularly so is the frequent existence of cardiac abnormality in Mongolian idiots.

**Varieties of Congenital Cardiac Disease.**—The following tabulations based in part on the statistics of Abbott<sup>1</sup> are quoted from Griffith's work.<sup>2</sup>

#### CLASSIFICATION OF FORMS OF CONGENITAL CARDIAC DISEASE

1. Anomalies of the septa	{ Patulous foramen ovale Perforate septum ventriculorum	
	(a) Valves	{ Pulmonary stenosis Pulmonary insufficiency Aortic stenosis Aortic insufficiency Mitral stenosis Mitral insufficiency
2. Anomalies of the valves and vessels	{ Patulous ductus arteriosus Stenosis of pulmonary artery Dilatation of pulmonary artery	
	(b) Vessels	{ Narrowing of aorta Dilatation of aorta Hypoplasia of aorta and vessels Transposition of great vessels
3. Anomalies in the size and position of the heart	{ Transposition of heart chambers	
	{ Dextrocardia	
	{ Congenital hypertrophy	
	{ Ectocardia	

<sup>1</sup> Osler and McCrae, *Modern Med.*, 1915, 342.

<sup>2</sup> *Diseases of Infants and Children*, 1919, vol. ii, p. 122.

## FREQUENCY OF DIFFERENT FORMS OF CONGENITAL CARDIAC DISEASE

Variety.	Number of cases.
Displacement of the heart.....	30
Partial defect of the interauricular septum.....	237
Partial defect of the interventricular septum.....	196
Complete defect of one or more septa, or of both.....	34
Anomalies in the origin of the arteries.....	184
Pulmonary stenosis or atresia.....	150
Aortic stenosis or atresia.....	21
Tricuspid stenosis or atresia.....	20
Mitral stenosis or atresia.....	9
Patulous ductus arteriosus.....	193
Stenosis (coarctation) of the aorta.....	102
Hypoplasia of the aorta.....	46

**Pathology.**—The initial and chief lesion in the majority of cases is at the pulmonary orifice, and is supposedly due to a fetal endocarditis which causes a stenosis. This, through interference with the blood-current, prevents a closure of the auricular or ventricular septum.



Fig. 78.—Clubbed fingers in congenital heart disease.

Cases are occasionally seen, however, in which the defect in one or other of the septa exists without atresia or stenosis at the pulmonary orifice.

Enlargement of the heart is the rule. Usually the right heart will be found particularly involved.

The above conditions represent some of the more common abnormalities. One who observes many autopsies upon children will have abundant opportunity to verify the above statements and to see other abnormalities which are of academic interest only.

**Symptomatology.**—Congenital heart disease is sometimes suggested by the appearance of the patient. There may be cyanosis, which is observed only when the child cries or strains, or the patient may be a "blue baby," in which case the cyanosis is permanent and of such a degree as to make the diagnosis positive without further aid than inspection.

In far the greater number of cases the defect is discovered upon routine examination with no external sign whatsoever indicating that a lesion exists.

**Classification of Lesions on Clinical Examination.**—It is a hopeless task to attempt to classify a congenital lesion according to the nature, maximum intensity, or transmission of the murmur. Even after the signs have evoked a common diagnosis from several observers autopsy may show conditions not flattering to the diagnostic acumen of the examiner.

In general, the following points may be borne in mind, in an attempt to diagnose the existing lesion in a given case:

Patent interventricular septum gives rise to a systolic murmur maximum at about the fourth left interspace near the sternum, not transmitted to the neck, and unaccompanied by thrill and cyanosis.

Pulmonic stenosis typically produces a systolic murmur heard over the second left interspace near the sternum and accompanied by a definite thrill. Cyanosis, enlargement of the right heart, and clubbing of the finger-tips are noteworthy.

Patent ductus arteriosus gives rise to a loud prolonged "humming-top" or "coffee mill" murmur heard in both phases of the cardiac cycle over the entire precordium and transmitted upward in the carotids. This condition often occasions little physiologic difficulty and might go on unrecognized were the heart not examined by the ear.

Patent foramen ovale, patent interventricular septum, and patent ductus arteriosus are compensatory in the presence of pulmonic stenosis.

Cyanosis and cardiac enlargement without audible murmur may be due to complete atresia or hypoplasia of the pulmonary artery.

**Diagnosis in Infants and Very Young Children.**—The most valuable diagnostic sign is a pronounced cardiac murmur in a child under eighteen months of age. Children before this period of life rarely have rheumatism, which is the cause of endocardial lesions in over 95 per cent. of the cases. The absence of cyanosis is no evidence against the diagnosis of a congenital lesion, as a great majority of the cases have not shown this symptom. On the other hand, there may be a *marked degree of cyanosis* and not the *slightest trace of a murmur*.

At autopsy such a case showed an entire absence of the ventricular septum.

First, then, the age of the child is strongly suggestive as to whether the condition is due to a congenital abnormality or acquired disease. If the patient is under eighteen months of age or even under two years, the lesion is, in all probability, congenital.

Second in importance is to be noted the character of the murmur, which is usually systolic and of a very loud, rasping character, heard loudest in the third or fourth left intercostal space with a very wide area of diffusion. Many of these murmurs may be heard over the entire thorax, both anteriorly and posteriorly.

**Differential Diagnosis in Infants.**—At this period of life the murmur of congenital heart disease has to be differentiated from the murmur found in anemia. Not all congenital murmurs are as characteristic as above described. They may lack the element of loudness and harshness and be soft and blowing in character. This, however, is of very infrequent

occurrence. In such an event a differential diagnosis between a congenital cardiac lesion and a murmur due to anemia is most difficult, for the anemic murmur is systolic in time, is heard loudest over the base, and has a fairly evenly distributed area of diffusion in all directions.

In such cases the blood examination is of decided service. In congenital heart disease there is almost constantly a very extreme polycythemia with high hemoglobin percentage and specific gravity, and a moderate increase in the white cells (Wood).

*Murmurs Due to a Definite Lesion.*—These are constant and vary little under different states. Whether the patient is at exercise, at rest, sitting, standing, or lying down, the murmurs are invariably present and vary only in intensity. This fact is a valuable aid in differentiation.

*The Functional Murmur.*—The chief characteristic of the functional murmur is the inconstancy of the sound, now loud, now weak. Not infrequently these murmurs disappear under stress and reappear when the stress is removed. They may disappear or become very faint with the patient recumbent, and reappear upon the return to the erect position. A relaxed heart muscle might be a cause of some of these cases.

The anemic murmur typically changes upon change in position of the patient, and during exercise it is inconstant.

**Diagnosis and Differential Diagnosis in Older Children.**—In children after the second year the differential diagnosis may be more difficult. It is to be remembered that in cases in which a congenital murmur is well marked at this period of life there will usually be other signs that may aid us in our judgment. Cyanosis is present in a larger proportion of the older patients than of the very young. This is to be explained by the fact that the child when very young calls upon the heart to a comparatively small extent. With the assumption of active play and with running, stair-climbing, and stress of any nature, the defective heart fails to meet the extra demands, and cyanosis, clubbed fingers (Fig. 78), and shortness of breath develop. At this age also the question of anemia and developmental conditions arises. Repeatedly patients are seen who show no inconvenience whatever until this more active period of life is reached.

*Murmur After Illness.*—The murmur of congenital disease is also to be differentiated from other functional murmurs than those of anemia (p. 406), which are practically all systolic in time and have a wide area of diffusion. These functional murmurs often occur during, or particularly after, severe illnesses, such as pneumonia or typhoid fever, when the heart has been severely taxed. With such a murmur there is no accentuation of the second sound, no accompanying dropsy or cardiac enlargement, and the murmur is inconstant and variable, being influenced by the activity of the heart and the position of the patient.

**Prognosis.**—The future of the child with the congenitally defective heart is very uncertain. A very few of these patients go on to the adult period of life and suffer no inconvenience. In by far the larger number of cases, however, the approach of the runabout and active period (if the child survives to this time), with the extra demand upon the organ that this age necessitates, results in failure of compensation, and dilatation, followed by the usual train of symptoms peculiar to right heart failure.

*Illustrative Case.*—A girl with congenital heart disease developed several attacks of angina and cyanosis at the thirtieth month. This continued at rather infrequent intervals for a year, when she died in an attack.

## PERICARDITIS

**Etiology.**—Inflammation of the pericardium is usually associated with endocarditis of rheumatic origin. No period of life appears to be exempt. Our youngest patient was six months of age. The disease occurs most frequently between the third and the twelfth years. Cases have been reported by different authors as occurring in fetal life. As the result of an infection the disease occurs not only in association with rheumatism but also as a result of the invasion of pathogenic bacteria carried through the blood-stream or by the lymph from other portions of the body. Before the third year pericarditis is associated with pneumonia and empyema with greater frequency than with any other disease.

**Bacteriology.**—The organism most often found in the serofibrinous or purulent exudate is the pneumococcus, a fact which is explained by the frequency of pulmonary lesions as the primary source of the infection in 70 to 90 per cent. of these cases. The streptococcus or the Staphylococcus aureus may be present; and very rarely Bacillus influenzae or the gonococcus has been found in the course of septicemia due to these bacteria. The tubercle bacillus, as the cause of fibrinous or purulent pericarditis in children, is almost unknown. Tuberculosis is more apt to involve the external surface of the sac owing to possible extension of tuberculosis of the lung.

Poynton has found the so-called "diplococcus of rheumatism" in the plastic exudate of pericarditis complicating rheumatism.

**Pathology.**—Pericarditis possesses as wide possibilities as pleuritis, and the pathologic processes are quite similar. Thus, there may be only simple dryness of the lining of the pericardial sac, or a complete filling of the sac with serous or purulent fluid. Over the heart and the enveloping membrane only thin layers of fibrin may form; or the heart and pericardium may become firmly bound together by layers and bands of fibrinous exudate. Autopsies in purulent cases often show the heart wrapped in the meshy fibrinous exudate to such a degree that the muscle surface cannot be seen, while the inner surface of the pericardium is lined with a granular exudate and the intervening space is filled with fluid serum or pus. On showing postgraduate students such specimens the senior author has witnessed complete failure of the entire class to recognize the organ before them, so great has been the change from the normal appearance.

**Symptoms.**—Pericarditis is a disease which stands out peculiarly because of the wide range of the possible symptoms. Thus a case of purulent pericarditis may run its course under the observation of excellent clinicians and not be recognized until the autopsy, or may produce symptoms of the greatest urgency and occasion intense distress to the patient. It is, therefore, impossible to lay down a symptomatology for the disease that will apply to all cases. Pericarditis is quite possibly more frequently overlooked by clinicians than any other disease.

Cyanosis is present. The expression is anxious. In urgent cases a

prominent symptom is extreme restlessness. Discomfort, pain, and a feeling of tension over the precordium are at times complained of. In other cases with apparently quite pronounced lesions there is little or no discomfort.

An important symptom indicating pericarditis is rapid respiration. Not only is the breathing rapid, as in pneumonia, but it is fairly characteristic in that the respirations are guarded. The patient appears to have his mind centered on breathing. Carefully guarded inspiration is taken and careful expiration is carried out. At the same time the respiration is hurried and short, although not precipitate. This cautious breathing is due to the feeling of decided discomfort, constriction, and even pain which accompanies the chest expansion. The respiration is somewhat similar to that of acute pleurisy. The individual is not sure that he will be able to complete respiration, and perhaps feels obliged to cut it short.

The very rapid heart action is the most reliable symptom of the disease, often exceeding in apparent severity all the other symptoms. We have repeatedly seen patients from eight to ten years of age with a temperature rise to only 100° F., with a pulse-rate from 130 to 150 or higher.

**Physical Signs.**—The first proof of pericardial inflammation is a rubbing, grating sound, known as the pericardial friction sound, heard over or slightly above the apex of the heart. The sound has a double quality and is heard both at systole and diastole, or perhaps only with systole, and in well-marked cases will be transmitted to the finger on palpation. Wherever heard the sound is distinctly localized. In cases of effusion in older children there may be bulging of the interspaces. With the appearance of considerable fluid the friction sounds cease, but return when the fluid is absorbed. In cases in which the friction is questionable or indistinct, it will be accentuated by having the child lean forward in a sitting position.

**Percussion.**—When fluid in considerable amount is present, the area of cardiac dulness will be increased, the apex-beat will be difficult to determine, and the normal heart sounds will become weakened. Obliteration of the cardiohepatic angle may be noted, although the findings of Morris and Little<sup>1</sup> indicated that in pericardial effusion this angle typically is acute.

In a fatal case in a six-year-old boy the apex-beat was not demonstrable, and the heart sounds could scarcely be heard.

It has not been our observation that the apex-beat is displaced upward, as is claimed is the case in adults. With the presence of considerable fluid—over 2 ounces in a child from three to five years of age—the dulness will be increased to the left and upward. Shifting dulness, if found on change from the recumbent to the erect sitting position, is most diagnostic.

With the larger effusion occurring in the boy above mentioned, the dulness extended to the right nipple and 1 inch outside of the left nipple.

<sup>1</sup> Amer. Jour. Med. Sciences, November, 1923.

The amount of fluid is difficult to determine in any case, and particularly so when endocarditis and myocarditis coexist, with accompanying hypertrophy and dilatation.

**Diagnosis.**—The x-ray is essential in doubtful cases. Differentiation between cardiac dilatation without effusion, pericarditis with effusion, and left pleural effusion is not at all times easy.

In every case of acute heart disease in a child the physician should be particularly careful to investigate the cause of exceptional rapidity of breathing and pulse-rate.

**Prognosis.**—The prognosis in rheumatic cases is good if proper treatment can be followed. We are dealing with a disease in which the management of the case determines to a large degree the outcome. Just how complete a recovery is made in the so-called recovery cases is difficult to determine, as there must be, in every case, adhesions between the heart and the pericardial sac. A condition known as adherent pericardium (p. 429) may be the outcome. The purulent cases, with so-called malignant endocarditis, have, with rare exceptions, been fatal.

The duration of the acute cases of rheumatic origin varies from a few to a considerable number of weeks.

**Treatment.**—In considering the treatment we may divide cases of the disease into two groups—those of rheumatic origin and those due to the invasion of well-known pathogenic organisms. In the *rheumatic cases* the sick-room management and the diet are the same as in the treatment of endocarditis (p. 419). In addition to the management pursued in endocarditis, additional symptomatic treatment is required.

For controlling excessive rapidity of the heart the tinctures of digitalis and aconite may be of much service. To a child eight months to three years of age  $\frac{1}{2}$  drop of tincture of aconite and 1 drop of tincture of digitalis may be given at two-hour intervals, but not to exceed six doses in the twenty-four hours. After the third year 1 drop of the tincture of aconite and 3 drops of the tincture of digitalis may be given at two-hour intervals—six doses in the twenty-four hours.

For the extreme restlessness which often exists codein or paregoric may be given. For a child under two years of age paregoric is safer. It may be given in doses of from 10 to 20 drops and repeated when indicated at intervals of two or three hours. Older children—between the second and sixth years—should be given codein in doses of from  $\frac{1}{10}$  to  $\frac{1}{6}$  grain. After the sixth year  $\frac{1}{4}$  grain may be given, to be repeated at three-hour intervals or less frequently, not more than three doses being given in twenty-four hours.

As soon as the diagnosis is made, if the case is of rheumatic origin, it is advisable to begin giving salicylate of soda with a view to prevention of effusion into the pericardial sac. The belief of various clinicians that rheumatic carditis is unaffected by salicylates does not justify neglect in the use of the agent acknowledged to be specific for rheumatism in general. To children under three years 14 to 20 grains of salicylate of soda should be given daily, with twice the amount of bicarbonate of soda. As the salicylate may cause some gastric disturbance, it should never be given when the stomach is empty except in milk or with some other food; 4 grains is as much as should be given at one time. After the third

year from 20 to 30 grains may be given. At the tenth year 40 grains may be given daily in divided doses, always in solution, under the same precautions as to giving the drug after meals. It is impossible and entirely unnecessary in this country to give the large doses of the salicylate which are given abroad.

For delicate children and those by whom the salicylate is not well tolerated, aspirin may be substituted; or the salicylate may be given by the bowel in doses of 15 grains at a time. The medicine should be diluted with at least 4 ounces of water and introduced through a rectal tube which has been inserted at least 9 inches. This procedure should be carried out not oftener than twice daily, and should be immediately preceded by irrigation of the large intestine.

In the comparatively infrequent cases in which *pericarditis complicates one of the infectious diseases*, the salicylate treatment is not to be advised unless there is some suspicion of rheumatism. The other methods suggested are to be carried out with the hope that the disease may be controlled. In this type of case the ice-bag is particularly serviceable (p. 420). In the event of effusion so excessive as to interfere with the heart action, producing orthopnea and cyanosis, with feeble, irregular pulse, operation on the pericardium, such as aspiration or incision and drainage, is to be considered, although in the few operative cases which we have seen we have not been impressed with the great usefulness of this treatment. On the other hand, we have seen cases, in which there was an excessive accumulation of fluid, recover under less radical measures.

*The Purulent Type.*—When it becomes evident that pus is present in the sac, incision and drainage may be attempted, as the case will surely be fatal if the usual methods are pursued. In this type the blood shows a very high white cell count with very high polynucleosis.

### ACUTE ENDOCARDITIS

Acute endocarditis is an inflammation of the endocardium or lining membrane of the heart. Probably in all cases showing even a moderate degree of severity there is involvement of the adjacent heart muscle, so that when there is an endocarditis there is a myocarditis as well, although the latter may be of little moment. Pericarditis has been a complication in about 5 per cent. of our cases. In the great majority of instances endocarditis is to be looked upon as a manifestation and not a complication of rheumatism.

*Etiology.*—Endocarditis is present in a considerable proportion of cases of chorea, the statistics of various authors varying from 6 to 55 per cent. Both the chorea and the endocarditis are active manifestations of rheumatism. In our own experience endocarditis has been present in not over 20 per cent. of the cases of chorea. Endocarditis occurs as a complication of scarlet fever, diphtheria, measles, and tonsillitis. In fact, there are few diseases of bacterial origin with which it has not at some time been associated. In 2 cases it was a complication of grip.

*Age.*—It is unusual to find endocarditis in children under three years of age. Few cases are seen between the third and fifth years. The period of greatest susceptibility is between the fifth and the twelfth years.

*Family susceptibility* to rheumatism, chorea, and endocarditis is noteworthy and has been emphasized in a study of 100 families by St. Lawrence.<sup>1</sup>

**Bacteriology.**—The vegetative forms of endocarditis are more frequently due to rheumatism than to any other infectious disease. Poynton and Payne demonstrated a “*diplococcus rheumaticus*” in the vegetations on the heart valves. The bacteria are said to be found readily only in the early stage of the endocarditis, tending to disappear in the later course of the disease.

The identity of the causative organism in rheumatic endocarditis is, however, still not universally granted. “The disease would appear to be a modified septicopyemia.”<sup>2</sup>

Acute ulcerative or septic endocarditis is more often a secondary than a primary condition, and is caused by the localization on the heart valves of bacteria from the blood-stream. The bacteria causing the primary infection are present in the valvular ulcers. Streptococci, staphylococci, pneumococci, gonococci, typhoid bacilli, colon bacilli, influenza bacilli, and diphtheria bacilli have been found.

In cases of malignant endocarditis the causative organism (not infrequently the *Streptococcus viridans*, as in adult cases) may be found by blood-culture.

In chronic endocarditis no bacteria are demonstrable in the endocardial lesions.

**Pathology.**—Inflammation of the membrane lining the heart affects chiefly the valves; and most frequently those guarding the mitral and aortic orifices. The latter fact has been explained by a theory that bacterial development is better favored by the fresh arterial blood of the left ventricle than by the venous blood (of low oxygen content) present in the right heart.

The margins of the affected cusps are thickened and covered with small masses of necrotic tissue, fibrin, red corpuscles, leukocytes, proliferating endothelial cells, and bacteria. The chordæ tendineæ are frequently involved and undergo shortening, thickening, and a certain amount of fusion. In the myocardium perivascular groups of cells are to be found in concentric layers. These foci, known as Aschoff's bodies, may ultimately be incorporated in a process of fibrosis.

In cases of mild infection the seat of the inflammation is at the base of the valves in the heart muscle and there is left no permanent lesion. More frequently, however, when the acute inflammation subsides the valves undergo considerable cicatrization and contraction, and exist thenceforth as deformed and more or less inefficient structures.

In the severe forms of the disease, commonly termed “malignant endocarditis,” destructive effects are much more marked, and ulceration of the mural endocardium may occur. In such cases emboli frequently become detached from the friable vegetations on the valves, and produce infarcts and abscesses in such remote organs as the brain, spleen, and kidney.

The usual sources of infection are wounds of the skin and mucous

<sup>1</sup> Jour. Amer. Med. Assoc., December 16, 1922.

<sup>2</sup> Reid, *The Heart in Modern Practice*, 1923, p. 97.

membrane, and inflammation of the alimentary, pulmonary, and genito-urinary tracts. Prominent in this category are diseased tonsils and teeth. Attacks of "simple" acute endocarditis may easily render the heart more susceptible to an infection of the malignant type.

**Symptomatology.**—By far the majority of cases of endocarditis present no symptoms whatever. Hundreds of these cases are overlooked because of this peculiarity of the disease, and because writers lay great stress upon a symptomatology of prostration, high temperature, and severity in general, that may occur in one out of 10 cases, the result being that 9 are overlooked. A large majority of the cases of endocarditis coming under our observation (mild acute endocarditis, not chronic valvular disease) have been discovered in the routine examination of the patient, and not because anything in the case had suggested the heart as a factor in the illness. Every physician who does considerable clinical work sees patients with valvular defects of long standing, who have no knowledge whatever that a heart lesion has existed. Clinicians who examine for life insurance will particularly appreciate the force of the above statement. We have repeatedly seen cases develop during or after tonsillitis in children with a rheumatic tendency, the endocarditis being the active manifestation of the rheumatism.

*Illustrative Case.*—A boy six years of age had a slight pain in his knee, which caused a limp. He had just recovered from a mild tonsillitis. In the routine examination acute endocarditis was found, involving both the mitral and aortic valves. The boy made a complete recovery.

There are doubtless many cases of endocarditis which pass unrecognized and terminate in recovery.

When acute symptoms are present, we find fever which presents wide variations—100° to 105° F.—depending upon the severity of the infection. The height of the temperature is usually a reliable indication of the gravity of the illness. With the high temperature there is increased heart action ranging from 110 to 140. If the action is irregular, myocarditis also may be suspected. Pain over the precordium and shortness of breath are usually present.

**Diagnosis.**—The symptoms alone may be sufficiently pronounced to suggest the existence of endocarditis. It is by the physical signs, however, that suspicion is verified and the diagnosis made possible.

*Inspection*, if it reveals anything abnormal, will show an excessive action of the heart, producing an undulating motion of the cardiac area, with visible apex-beat.

*Palpation* confirms the existence of this overaction of the heart and may detect a thrill corresponding to the murmur found on auscultation.

*Percussion* may reveal cardiac enlargement. The left ventricle becomes dilated early in the severe cases.

*Auscultation* will reveal either a murmur (p. 404) or a combination of murmurs. In character the murmur may be soft and blowing, or harsh, rough, and grating. It may be systolic, diastolic, or presystolic; or it may be double, presystolic and systolic, or diastolic and systolic. The fact that the left side of the heart is always involved simplifies materially the localization of the lesion.

If due to mitral regurgitation, the murmur is usually soft and blowing in character, heard loudest at the apex, transmitted to the left axilla, and plainly heard between the scapula and the spine.

In mitral stenosis the murmur is presystolic in time, and is heard loudest just above the site of the apex-beat. This murmur is not transmitted elsewhere, and is accompanied by a thrill (p. 405).

When there is combined mitral stenosis and regurgitation the systolic murmur follows immediately upon the presystolic, making a prolonged murmur which completely obliterates the first heart sound.

Aortic stenosis produces a systolic murmur, heard loudest at the second interspace, over the middle of the sternum, or at its immediate right border, and transmitted upward to the carotids.

In aortic regurgitation the murmur is diastolic in time and is usually heard loudest over the second and third left interspaces.

**Differential Diagnosis.**—Endocarditis may be confused with temporary functional disturbances of the heart, giving rise to functional murmurs (p. 406). This statement, of course, applies only to mitral disease. After many disorders in children in which the heart has been severely taxed, a soft, blowing, systolic murmur develops. This murmur, however, is inconstant, changes more or less, or disappears upon change in the position of the patient, and, most important of all, has no line of transmission and is not heard at the back. After a few days or weeks, providing proper management is carried out, such murmurs disappear.

**Prognosis.**—The outlook, in a great majority of cases of endocarditis, is favorable for a complete recovery. In other cases, even under the best of management, the patient, after recovery from the acute disease, is left with crippled valves. When there is a very severe infection of the so-called *malignant type* the outlook is most unfavorable.

*Illustrative Case.*—A boy seven years of age died within forty-eight hours from the onset of the heart involvement.

A considerable number of similar fatal cases have been encountered in consultation work.

The inflammation in such cases usually develops rapidly into a pancarditis, the heart muscle, the pericardium, and the endocardium all becoming rapidly involved, with resulting dilatation of the heart, which is often extreme.

In such cases there is usually a general septicemia.

**Treatment.**—*Rest in Bed.*—Whatever the nature of the infection, and whether the disease is mild or severe, one rule—that regarding quiet and rest must be consistently followed. The child must remain in a recumbent position in bed, the bed-pan being used to receive the excreta. The use of the arms and the hands should be discouraged, particularly early in the attack, as it is at this time that the greatest damage is done to the heart. Reaching from the bed to the floor or to the table or chairs should be forbidden. The heart must be given as little work to do as possible.

*Prolonged Inactivity.*—In both pericarditis and endocarditis absence of stress of any nature should be secured until every evidence of the

disease has disappeared, or at least until the heart becomes regular, and its rate, under a test of moderate exercise, approximates the normal.

*Illustrative Case.*—The longest period we have kept a patient recumbent was six months. This patient is now a young man, and all that remains of his very extensive endocarditis and pericarditis, comprising three distinct attacks, is a slight mitral regurgitant murmur with full compensation.

Every patient is kept off the feet for at least six weeks, and several have not been allowed to take a step within three to six months.

*Diet.*—The diet should consist largely of fluids, administered in comparatively small amounts, at shorter intervals than in health. The bowels should move once daily. If a laxative is necessary, a saline should be given. A Seidlitz powder or magnesium citrate is usually effective. Distention of the stomach, whether by gas or by food, causes pressure on the heart and increases its labor. It is a good custom, in these cases, to give five feedings in twenty-four hours, and not more than 8 ounces at a feeding. Four ounces of milk and 4 ounces of gruel, with zwieback or toast, constitute the usual feeding. In order to vary the diet a weaker gruel, No. 1 (p. 94), flavored with an ounce or two of chicken or mutton broth, may be given; or a gruel of the same strength may be given plain, with sufficient salt to make it palatable. If the milk is well borne, it may be increased until 1 quart is taken daily. The enforcement of a strict milk diet is a mistake. The child very soon tires of it, digestion is impaired, and nutrition is correspondingly faulty. As improvement becomes apparent eggs, bread and butter, stewed fruit, poultry, fish, and plain puddings may be added to the diet. In order to facilitate freer feeding the number of meals should be reduced.

*The Ice-bag.*—A screw-top ice-bag half-filled with chopped ice should be placed over the heart, and, if possible, kept on continuously. Children frequently become restless and irritable under too constant application of the ice, and in such instances it may be left off occasionally for half an hour or an hour. Gilman and White<sup>1</sup> have shown that "the greatest effectiveness might be achieved by alternating half-hour periods."

A most reprehensible practice is the overfilling of the ice-bag to such a degree that its weight is a direct physical burden upon the heart.

*Drugs.*—In endocarditis following diphtheria or the exanthemata drugs are of little benefit. Salicylate of soda seems to have no beneficial effect upon these patients. For excessive rapidity of the heart action digitalis is more effective than any other drug. To children from five to ten years of age 3 to 6 drops may be given at intervals of from three to six hours. When a more rapid effect is desired the Eggleston method and dosage may be followed (p. 428).

If there is much excitability and restlessness,  $\frac{1}{2}$  grain of codein or 8 grains of sodium bromid may be given at sufficiently frequent intervals to control the condition. While every case of non-rheumatic endocarditis presents possibilities of serious and permanent damage to the heart, not every case, by any means, is of sufficient severity to demand other treatment than the ice-bag, rest, and an easily digested diet. It is often the milder cases that occasion the gravest sequelæ, on account

<sup>1</sup> Jour. Amer. Med. Assoc., September 1, 1923, p. 748.

of the lack of objective symptoms, and the liberties given the child by parents, who are with difficulty convinced of the gravity of the disease.

*Antirheumatic Treatment.*—Every case of endocarditis under our care, which is not directly associated with one of the specific infectious diseases, is considered and treated as though it were a case of *rheumatism*, owing to the exceeding frequency of this form of infection. Sodium salicylate and sodium bicarbonate are early brought into use. To a child between five and ten years of age from 3 to 5 grains of sodium salicylate with an equal quantity of sodium bicarbonate are given after each feeding five times daily. The medicine may be given in capsules or in solution. If the sodium salicylate is not well borne by the stomach, the equivalent dosage of aspirin or oil of wintergreen may be given. The salicylate should be continued with occasional intermissions of a day or two until such urgent symptoms as fever, rapid heart-rate, and dyspnea have subsided. The dosage should then be varied, 10 grains being given daily for five days out of fifteen.

A child who has recovered from rheumatic endocarditis should be kept under close observation, and the parents should be warned as to the possibilities of a second attack.

*Illustrative Cases.*—*Case 1.*—In a private case, in spite of antirheumatic treatment, during the intervals four distinct attacks occurred during five years.

*Case 2.*—A dispensary patient at the New York Polyclinic had his first attack when four years of age. So prominent was his rheumatic tendency that during the next four years, in spite of active antirheumatic treatment and a careful diet in the intervals, he had eight distinct attacks of endocarditis, and died from the heart involvement in his eighth year. There were other manifestations of rheumatism in his case, and his family on both sides for several generations had been markedly rheumatic.

*Convalescence.*—When the pulse-beat is reduced to 100, which is not to be expected earlier than the fourth week, the patient may be allowed to sit in a reclining chair. Previous to this, while still in bed, he may be gradually accustomed to elevation of the head by the addition of an extra pillow for an hour or more daily. Greater freedom is permitted when it is found that the patient can be indulged and the heart-rate still be kept below 100.

*Recurrence.*—Inasmuch as a recurrence is very probable, the patient, even while in apparent health, should have the benefit of a restricted diet, being allowed red meat but twice a week and a minimum amount of cane-sugar. During five days out of each month he should receive 10 grains of sodium salicylate and 10 grains of sodium bicarbonate daily. This scheme of medication should be continued for at least two years, and much longer if the patient shows any further rheumatic manifestation, such as pains in the legs, or repeated attacks of tonsillitis. The length of time during which absolute rest in bed is to be enjoined depends on the severity of the case. This time in most primary cases is from six weeks to three months.

*Illustrative Case.*—In the case of a boy who had had a very severe second attack, walking was not allowed for six months, the patient using a wheel-chair instead.

In a case of moderate severity in which the fever may have continued for only a week or ten days, the heart action, which has ranged from 140

to 160, gradually becomes less frequent. The rapidity of the heart rate is the best guide in deciding when walking shall be permitted, and a safe rule is to permit increase in activity only when the pulse is consistently below 110.

Every child who has had acute endocarditis should have the tonsils enucleated. Dental foci of infection must likewise be eradicated.

**Conclusion.**—The above scheme of management may seem unnecessarily severe, but we must remember the importance of the heart in the economy, and see to it that if the patient cannot have a perfectly sound heart, it shall be damaged as little as possible. The treatment thus comprises the observance of every precaution that will tend toward the best possible outcome, no matter how drastic may be the requirements.

### MYOCARDITIS

Myocarditis of mild degree is a frequent accompaniment of inflammatory disease of the pericardium and endocardium. The most severe cases, however, may not be of this type.

**Etiology.**—Acute parenchymatous myocarditis may follow various processes, but is most often due to the activity of the toxin of the pneumococcus, the typhoid bacillus, or the diphtheria bacillus. Inflammation of the endocardium or the pericardium may extend to the myocardium.

Further references to the causation of this disease are included in the discussion of the pathology.

**Pathology.**—Classifications of myocarditis are more or less artificial. Acute and chronic forms and parenchymatous and interstitial types of inflammation are recognized.

*Acute parenchymatous myocarditis* usually results from an acute infection or toxemia, such as diphtheria, typhoid, or scarlet fever. The heart muscle is pale in color, soft, and somewhat friable. The heart itself may be dilated. Microscopically, the muscle-cells show granular, hyaline, and fatty degenerative changes, and frequently contain vacuoles; the nuclei stain imperfectly. In the interstitial tissue polynuclear and lymphocytic infiltration and even some extravasation of blood may occur, these conditions being most marked in the neighborhood of blood-vessels.

The reparative process is largely that of replacement fibrosis, a productive inflammation terminating in the substitution of fibrous connective tissue for the degenerated cells. Development of new muscle tissue also occurs. This, however, is probably brought about by simple hypertrophy of undegenerated muscle-fibers, rather than by true hyperplasia of these elements.

*Acute suppurative myocarditis* may result directly from an abscess in the mediastinum or a purulent pericarditis, but is more frequently due to a general pyemia caused by the pneumococcus, streptococcus, staphylococcus, or gonococcus. The wall of the heart contains miliary pus foci and small extravasations of blood. Microscopic examination shows the vessels to be filled with embolic products, and surrounded by the small hemorrhagic areas and collections of pus-cells already described. The process, although essentially one of interstitial inflammation, is regularly accompanied by considerable degeneration of the muscle-

fibers. In the rare cases when recovery from suppurative myocarditis occurs, the defects in the heart are remedied by fibrous tissue.

*Chronic interstitial myocarditis* in childhood is a productive reparative process, usually secondary to inflammation of the acute type. The development of this condition to compensate for atrophy of the heart musculature caused by defective blood-supply through partially occluded coronary arteries is essentially a change of later life. When due to syphilis, chronic myocarditis in children is usually accompanied by endarteritis. Gummata are rare, although *Treponema pallidum* may be demonstrated in the myocardium.

**Symptoms.**—The most characteristic early sign of myocarditis in a child is a persistently irregular pulse, with or without a tendency to increased rapidity. It is not at all essential that the pulse be rapid—in fact, it is not at all unusual for it to be slower than normal. When such irregularity occurs after an acute disease, and particularly when there are occasional periods of cyanosis, myocarditis may be expected. It is often difficult to judge accurately of the heart's action when the child is awake, because of the excitement and possible resistance which the presence of the physician may occasion. For this reason, in suspected cases, the child should be examined, if possible, when asleep.

When the child develops the above symptoms he should be watched with the greatest solicitude, as the more urgent symptoms of pallor, marked cyanosis, and syncope may occur at any moment. The pulse becomes very irregular and thready, or it may be lost entirely at the wrist, the patient presenting a picture of impending dissolution. In pneumonia, in virulent cases of diphtheria, and in the exanthemata the symptoms of acute myocarditis are those of early heart failure and are of grave significance. The pulse becomes rapid and irregular, cyanosis is constant, and the respiration is increasingly difficult because of the sense of pressure and constriction in the cardiac region.

In diphtheria a sudden extreme drop in the rate of a previously rapid heart is of serious import and may be due to heart-block (p. 408).

**Diagnosis.**—The diagnosis of myocarditis is based upon the irregularity of the pulse following an acute infectious disease, and upon the sudden attacks of cyanosis and collapse. Auscultation is of value only in demonstrating the weakness and indefiniteness of the first sound.

**Treatment.**—*Rest in Bed.*—When the condition follows even a mild attack of one of the infectious diseases, the invariable rule of absolute heart rest, which is by far the most important feature of the treatment, must be insisted upon. The patient, whether in hospital or in a private home, should not be allowed to sit up or even to raise his head from the pillow; a trained nurse should remain constantly in attendance, so that the child may be read to or otherwise entertained while physical exertion is prevented. He may be permitted to use his arms, to play with simple light toys, but all other exertion must be prohibited. Aside from provisions for the recumbent position, quiet, a daily bowel evacuation, and easily digested food given in small quantities, little treatment is required. It is important to keep the stomach free from distention with either gas or food. Small quantities of nourishment administered at frequent intervals are preferable to large quantities given at the usual mealtime.

*Drugs.*—In the more severe cases with cyanosis and dyspnea a hypodermic containing strychnin, 1/50 grain, and digitalin, 1/100 grain, should be kept constantly at the bedside.

In one case following scarlet fever so urgent were the symptoms that three physicians were engaged for several days, each being for eight hours' duty at the bedside, in addition to the two trained nurses, each of whom was doing twelve hours' duty.

Strychnin has been routinely given with the thought of possible associated involvement of the cardiac ganglion. Moreover, certain portions of the heart muscle obviously remain free from the degenerative process and may be favorably influenced by the strychnin. To a child one year of age 1/200 grain may be given three times daily. From the first to the third year 1/200 to 1/100 grain may be given four times daily. After the third year the dose is subject to considerable variation, the amount depending upon the urgency of the case. Ordinarily, from 1/100 to 1/75 grain may be given four times a day. If the case is very urgent and the strychnin appears to improve the heart action, it may be given to the point of producing its physiologic effects, such as fibrillary twitching of the muscles of the face and the backs of the hands. Nitroglycerin should not be used. Digitalis should be given with care to young children, as it is very apt to disturb the digestion if long continued; temporarily, in treating older children, it may be used with advantage. A child from five to ten years old may be given thrice daily (preferably after meals) from 3 to 4 drops of the tincture well diluted with water. The tincture of strophanthus may be of more service than the digitalis. Digitalis or strophanthus will be found particularly useful in those cases in which there is a tendency to rapidity of the heart action. A child one year of age may be given 1 drop of tincture of strophanthus every two hours in the twenty-four; from the first to the third year from 1 to 2 drops at two-hour intervals; and from the third to the tenth year from 2 to 4 drops at intervals of from two to three hours.

*Convalescence.*—The tendency of myocarditis in children is toward recovery. How long each patient will require strict observation, and how long the treatment will ultimately need to be continued, must be determined by each individual case. One fact to be remembered, according to our experience, is that the child either dies suddenly or makes a complete recovery, so that in treatment it is well to err on the side of caution. It has been found safe, in a very few instances, to allow the child to sit up after six weeks.

In the very severe case above referred to it was not safe for the patient to sit up in bed until the end of the third month, and he was not allowed to walk until the end of the fourth month. After being kept under observation for one year he was discharged, and has remained well during the ensuing years. At the present time there is no evidence whatever of his former illness.

A safe rule to follow is to keep the patient in bed as long as the rapidity or irregularity of the heart exists. When the heart action in the recumbent position is apparently normal, the patient may be allowed to have his head raised by an additional pillow. In this way the head and shoulders may be gradually raised higher day by day, so long as the

effect upon the heart muscle is not unfavorable. In the same way standing and walking may be gradually resumed. Following out this careful method of heart rest, and being governed solely by the heart action, which indicates the heart power, one will see apparently hopeless cases completely recover. Whether fibrous changes in the myocardium are present which may have a later influence there is, of course, no means of knowing.

### CHRONIC VALVULAR DISEASE OF THE HEART

Chronic valvular disease of the heart (acquired) is the end-result of an endocarditis which has resulted in certain changes in the valves and cardiac orifices, producing a permanent lesion. The acquired lesion in children will practically always be found on the left side of the heart, involving the mitral or aortic valve. With such lesions, compensatory hypertrophy, a conservative process, is usually associated.

**Etiology.**—A most important feature to keep in mind in connection with valvular disease of the heart in children is the source of the disease. A large proportion of the cases (95 per cent. in our own experience) are due to rheumatic endocarditis. In the absence, then, of a history of endocarditis in association with pneumonia, diphtheria, or scarlet fever, which association in our experience has been rare, it may be assumed that the valvular lesion is of rheumatic origin, even though there may not be elsewhere, at the time, positive evidence of rheumatism. Not a few children showing cardiac disease without a history of actual acute rheumatism have a history of tonsillitis, angina, coryza, asthmatic bronchitis, or chorea, all showing recurrent tendencies. Such patients will often be found to have a rheumatic or gouty ancestry, and not infrequently they themselves are hearty eaters of red meat and sugars.

The great majority of cases of valvular defects recognized in early adult life are the result of unrecognized endocarditis of childhood.

Janeway<sup>1</sup> found that proved bacterial endocarditis is one of the rare causes of chronic valvular disease.

**Symptomatology.**—Chronic valvular disease in children may exist unchanged for years if the lesion is not severe and if compensation is maintained.

The first symptoms of failure of compensation are *shortness of breath* and *rapidity of heart action*, both of which the child may mention in describing the condition. If the heart is not relieved, the patient will soon present evidence of right heart failure, such as persistent general bronchitis, inability to assume the recumbent position, dropsy, and enlargement of the liver and spleen. Later the breathing becomes more difficult, the expression anxious, and the face drawn and cyanosed upon the slightest exertion. The superficial veins become dilated, and the pulse finally becomes very irregular and soft. Death in children with this disease is usually due to terminal bronchopneumonia.

**Diagnosis.**—Valvular lesions are indicated by adventitious heart sounds, known as murmurs (p. 404), which are heard either with, or in place of, the normal sounds (p. 401).

The character, time, point of maximum intensity, and area of trans-

<sup>1</sup> Boston Med. and Surg. Jour., vol. clxxiv, No. xxvi.

mission indicate the location, and to a fairly accurate degree the nature of the lesion.

**Prognosis.**—The prognosis depends to a large degree upon both the location and the nature of the lesion. In mitral regurgitation with good compensation the possibilities for long life are favorable depending somewhat, of course, upon the age and condition of the patient. If the case is of long standing, the possibility of a complete cure is not to be considered. An unknown factor in these cases which has important bearing upon the future is the possibility of reinfection. When rheumatic endocarditis has once existed in a child, it is likely to return; and in the event of recovery from a second or third attack, the heart is left in a more serious condition than ever before.

Mitral regurgitation with good compensation may not seriously inconvenience the individual for years if careful habits of life are followed. Neither need a mild degree of uncomplicated aortic stenosis cause great anxiety. Nevertheless, we always look upon stenosis at either the mitral or aortic orifice with apprehension, and our own results with the stenosis cases during years of observation have been far from satisfactory. Aortic regurgitation is often associated with aortic stenosis, and the outlook for such patients as well as those with mitral stenosis is not favorable as regards the duties of active adult life.

If there is one word more than another that typifies the life of a child, it is the word "stress." Activity and excitement are so inseparable a part of child life that the heart crippled by aortic disease is often called upon to do work which is impossible. Even if the patient attains the fifteenth year without loss of compensation, the heart is in a condition that entails semi-invalidism.

**Treatment.** Realizing that rheumatic endocarditis is very likely to return, we should make it our first duty, after ascertaining ourselves as to the probable origin of a given case of valvular disease, to explain to the parents that other attacks are very likely to occur unless means are used for prevention. Enucleation of the tonsils and removal of bad teeth should be practised here as after acute endocarditis.

In the absence of a history of endocarditis in association with pneumonia, diphtheria, scarlet fever, or other infections, it may be assumed that the lesion is of rheumatic origin, even though a history or actual evidences of rheumatism may be lacking.

Our next step in the management must be to regulate the life so as to prevent a recurrence of the heart involvement. With this end in view, it should be directed that red meat be given the child but once every second day, and that cane-sugar be given in great moderation.

A diet of plain, nutritious food, with nothing between meals, is a very important feature in the treatment of heart disease in children. Poultry, fish, eggs, milk, and cereals with high protein content may be given in increased amount in order to maintain nutrition. A full-bath followed by a dry rub should be given daily. The bowels must not be allowed to become constipated, and moderate exercise should be encouraged.

The importance of woolen underclothing if only of light weight should be emphasized in dealing with the rheumatic child, and protection from

sudden temperature changes should be insisted upon even if a complete change of climate seems necessary to secure such protection.

*Drugs Advised.*—For five successive days out of each month a patient from five to ten years old should be given, after meals, 5 grains of salicylate of soda and 10 grains of bicarbonate of soda. This, with the low meat and low sugar diet, is usually, but not invariably, sufficient to prevent a recurrence. Occasionally it becomes necessary to give the above treatment for five days with intervals of only ten days. An interesting outcome apparently to be attributed to treatment has repeatedly been an entire disappearance of the growing pains, recurrent bronchitis, or low-grade eczema, with which the child may have been afflicted.

*Drugs Used With Caution.*—The further management of valvular disease depends to a certain extent upon the location and nature of the lesion. Because a child has a cardiac lesion he does not necessarily require digitalis. Not a little harm is done, in the treatment of diseases in children, by giving powerful drugs when they are not indicated. Too often in heart disease the physician feels his duty done when he gives digitalis. Many times children will be found taking digitalis and strychnin because of some cardiac lesion, while, at the same time, they are suffering from constipation, recurrent respiratory disorders, and persistent indigestion due to dietetic errors, all of which have escaped the attention of the physician.

*Mitral Regurgitation.*—In mitral regurgitation, well compensated, the activities need be but little curtailed; in fact, the patient may be encouraged to indulge in outdoor exercise, although competition in all games requiring unusual exertion, tests of speed or endurance of any nature, such as running and racing, should be forbidden. When the child is old enough, swimming, bicycling, horseback-riding, and golf may be advised. Boys, on arriving at the tobacco and alcohol age, must be told the dangers attending the use of either drug, and both must be forbidden. Girls with mitral insufficiency must be warned against excessive dancing, rope jumping, tight lacing, and indiscriminate eating. For patients of both sexes rational exercise is beneficial.

*Mitral Stenosis and Aortic Disease.*—When the aortic valves are involved either in insufficiency or stenosis, or when there is a considerable degree of mitral stenosis, the child's activities should be considerably limited. Under these conditions, with a view to the future, regardless of satisfactory existing compensation, it is essential to forbid the bicycle, swimming, dancing, baseball, or any sport or game which may call for much physical effort. Plenty of entertainment may be provided which does not call for great effort. The nature of the disease should be fully explained not only to the parents but also to the patient when the latter is old enough to understand, so as to secure hearty co-operation in governing the child's activities. Moreover, parents should be told particularly that tonsillitis or angina is a danger-signal, and that, on the occurrence of either condition, the salicylates are to be brought into use at once, even before the physician is summoned.

Ordinarily, it is not well to talk over a child's ailments with him or in his presence. To older children with cardiac disease, however, it is advisable to explain as clearly as possible the nature of the illness, and

insist that certain measures, particularly such as relate to restriction of activity, shall be carried out indefinitely. In this way better co-operation on the part of the patients is secured than if they are simply given a list of dogmatic "don't's." It is, furthermore, most important, in cases showing aortic involvement or mitral stenosis, to advise what is known as "heart rest." Every day after the midday meal, with clothing off or loosened, the child should be made to rest in a recumbent position for at least one hour. During this time he may sleep or read as suits his individual taste.

*Constructive Medication.*—As most of the cases of valvular disease in children are of rheumatic origin, it will be found that the majority of the patients are suffering from a mild degree of anemia. All the benefits of good nutrition, fresh air, and regularity in living referred to under Tardy Malnutrition (p. 146) should be secured to these children. Iron alone or with arsenic is here of some value when given with a suitable diet. A method often followed is to give, for five days, the salicylate and bicarbonate of soda already referred to; for fifteen days iron and arsenic; and during the remaining ten days of each month no medication, unless cod-liver oil is well borne, in which case this may well be given in combination with the extract of malt. If the patient can swallow a capsule, the following is recommended:

R.	Liquoris potassii arsenitis . . . . .	gtt. xc
	Extracti ferri pomati . . . . .	gr. x
	Quininae bisulphatis . . . . .	ʒi
	M. ft. capsulae no. xxx.	
	Sig.—One after each meal.	

If the iron produces constipation,  $\frac{1}{3}$  to  $\frac{1}{2}$  grain of the extract of cascara may be added to each capsule.

*Heart Stimulants.*—Aside from such tonic medication, drugs affecting the heart itself should not be given unless compensation fails. This may take place temporarily, regardless of the nature of the lesion, after some forbidden exercise, or during an acute illness sufficient to produce prostration. Such failure may occur permanently in cases which, for any reason, do badly. In the event of defective compensation and dilatation, the child should be kept in bed until the normal heart action is restored by rest, or until it is demonstrated that the aid of heart stimulants is required. In these cases (particularly in those of the latter type, when there is a rapid, irregular pulse, difficult breathing or excitement, and dropsy) the time-honored remedy, digitalis, is to be brought into use. For children we prefer ordinarily to use the tincture. To a child from five to ten years old from 3 to 5 drops may be given after meals three or four times daily. This drug, because of its well-known irritant effects upon the stomach, should be given considerably diluted.

In the administration of digitalis, when it is desired to obtain the therapeutic effect as rapidly as possible, the dosage may be regulated according to the Eggleston method.<sup>1</sup>

This method employs as the average therapeutic dose of a first-class tincture 0.145 c.c. for each pound of the patient's weight. "In this way it is possible to give a third to half of the total calculated therapeutic dose at a single administration, to follow this in from four to six hours with a

<sup>1</sup> Cary Eggleston, *Archives Int. Medicine*, vol. xvi, pp. 1-32.

quarter to a third of the total dose, and to give the remainder in a few doses of smaller size at intervals of from four to six hours. By this plan of administration the full effects can be secured in from twelve to thirty-six hours in the majority of cases."

Beneficial effects will be apparent first in the relief of the dyspnea, the pulse becoming regular and of increasing volume; and later in the increased excretion of the kidneys and the disappearance of the edema. The amount of digitalis given should be reduced as soon as the condition will allow, but the medicine may be continued for a considerable time after the patient is up and about. The only contraindications to the use of digitalis in children are its effect upon the stomach and the occurrence of heart-block (p. 408). When loss of appetite results, the preparation should be discontinued. In this event the tincture of strophanthus, which is referred to repeatedly in this work as a heart stimulant, may be substituted in the same doses. In cases requiring a cardiac stimulant for a considerable time or permanently, satisfactory results have followed the practice of alternating the digitalis with the strophanthus, giving each for five days.

The child, however, who requires constant cardiac stimulation promises but little for the future, and, in our experience, few patients of this type have survived the eighteenth year.

#### ADHERENT PERICARDIUM

As a result of an unresolved pericarditis with which a myocarditis may or may not have been associated, adhesions often exist which bind the pericardium to the heart muscle, in most instances completely obliterating the pericardial sac. The condition is found in cases in which there is extensive cardiac disease, with hypertrophy, dilatation, and valvular involvement.

**Diagnosis**, if made at all, is usually made at the autopsy. The diagnostic sign of real differential value is a retraction of the chest wall in the interspace corresponding to the apex-beat. Sometimes permanent cardiac friction-sounds may be heard, and there usually is an increase in the cardiac dulness to the right of the sternum.

### XIII. THE BLOOD AND BLOOD DISEASES

#### THE BLOOD IN THE NEWBORN

ACCORDING to Schiff, Perlin, Carstanjen, Scipiadès, and Takasu the blood of a newborn baby exhibits numerous characteristic changes.

1. The *specific gravity* averages between 1.060 and 1.080, but during the first two weeks rapidly sinks to its lowest point, at which it usually remains until the end of the second year of life, after which it rises until puberty, the average thus being between 1.050 and 1.055.

2. The percentage of *hemoglobin* is very high—usually between 100 and 140 per cent. of that found in the healthy adult.

3. The *red cells*, which are greatly increased, may number as high as 7,550,000, and usually above 5,000,000.

4. The *white cells* are also increased, in one case numbering 36,000.

5. According to Carstanjen, the polymorphonuclears number 73.4 per cent., as compared with 16.05 per cent. lymphocytes.

6. A large number of *nucleated red cells* are present up to the sixth day, after which scarcely any are to be found.

The variations noted become less marked after the fourth day. The number of polynuclear leukocytes diminishes, and after the fourth day the percentage of the various kinds of leukocytes is fairly constant during the first few months.

It is suggested that many blood changes observed in the newborn are due to the lack of water, a considerable amount of which is lost through the intestine and in the form of perspiration.

#### THE BLOOD IN INFANCY AND CHILDHOOD

**Hemoglobin.**—Throughout the period of infancy and childhood the hemoglobin is lower than in the adult, its minimum being usually reached between the third month and the second year. From this point it gradually increases until puberty. The average hemoglobin of childhood is between 65 and 85 per cent., the former being considered a low limit for a healthy child.

**Red Cells.**—The average number in infancy is from 4,000,000 to 5,500,000, and in later childhood from 4,000,000 to 4,500,000 (Hayem). In the blood of the fetus and in premature infants nucleated cells are seen, but in later infancy their presence must always be considered pathologic. Formerly their occurrence even in healthy children was considered the rule.

**Blood-platelets.**—These are normally present to the number of about 350,000 per centimeter.

They are now regarded as "pinched off" processes of giant-cells of bone-marrow varying from 2 to 5 microns in diameter. For their study the Wright and Kinnicutt method of dilution with a cresyl blue and potassium cyanid mixture is considered standard.

The blood-platelets are diminished in aplastic conditions of bone-marrow, as in pernicious or aplastic types of anemia, in severe infectious diseases, and in purpura hemorrhagica. In leukemia, trichinosis, and following hemorrhage the platelets are abundant.<sup>1</sup>

**Normal White Corpuscles.**—In health the following varieties are found:

1. *Lymphocytes.*—These cells vary from 5 to 10 microns in diameter. The nuclei are relatively large, round, deeply stained, centrally placed, and contain one or two nucleoli. The cells may be deeply notched, especially the smaller ones, and even suggest polymorphonuclear cells, but are never identical in appearance. The protoplasm forms a narrow rim around the nucleus and is sometimes reticulated. The nucleus stains with basic dyes more faintly than the protoplasm. The larger cells of this group have an irregularly staining nucleus with a chromatin network and a margin of faintly granular protoplasm. The lymphocytes constitute from 40 to 60 per cent. of the leukocytes in the normal infant's blood.

2. *Large Mononuclears.*—These are not polymorphous cells, but contain a single round or large oval nucleus, and are usually two or three times as large as red blood-cells. The protoplasm is homogeneous and relatively large in amount. These cells constitute about 4 to 6 per cent. of the leukocytes.

3. *Transitional Cells.*—These are usually larger than the large mononuclears, which they closely resemble; in fact, they are the largest cells of the blood. They possess a "wallet" or "saddle-bag" nucleus. During the first few months they comprise 8 to 10 per cent. of the white cells (Carstanjen, Karnizki).

4. *Polymorphonuclear Neutrophils.*—These cells, which constitute from 18 to 40 per cent. (Emerson) of the child's blood, are somewhat smaller than the transitional cells. The nucleus is characterized by its polymorphous nature and its deep stain, while the protoplasm is well filled with neutrophil granules, which may cover the nucleus.

5. *Eosinophils.*—These are usually of the same size as the preceding, and occasionally a little larger. The nuclei are fairly well stained, while the protoplasm is filled with large eosinophilic granules. These cells constitute 2 to 4 per cent. of the normal white cells.

6. *Mast Cells.*—These are about the same size as the preceding, but frequently smaller; they have a trilobed nucleus and a protoplasm containing many large basophilic granules; often they are metachromatic. Their proportion is about 0.5 per cent. of the white cells.

#### **Leukocytes Found in Pathologic Conditions:**

1. *Myelocytes.*—While any cell of bone-marrow is, strictly speaking, a myelocyte, by this term is generally meant one with a round nucleus and a granular protoplasm. Neutrophilic and eosinophilic myelocytes occur. Their size varies from that of the large mononuclears to that of red corpuscles. The nucleus is round, oval, and sometimes kidney shaped, but never polymorphous; it is usually centrally placed, and is not stained diffusely by any good nuclear dye. The protoplasm may contain many or few granules of the neutrophilic type.

2. *Eosinophilic Myelocytes.*—These resemble the polynuclear eosinophils, except for the rounded, undivided nucleus.

<sup>1</sup>Stitt, Practical Bacteriology, Blood Work, Parasitology, 7th ed., pp. 328, 329.

In pathologic conditions the leukocytes undergo various degrees of degeneration, both acute and chronic. There may be swelling, fragmentation, and hydropic and fatty degeneration, with nuclear changes.

According to Rieder, the leukocytes average from 8700 to 12,400 between the second and fourth days; after the fourth day, from 12,400 to 14,800. In infancy the variations are from 9000 to 14,000; in later childhood, from 6000 to 12,000. When the second year is reached, the blood gradually begins to assume the adult type. This, however, is not attained until the fifteenth or sometimes the twentieth year. Up to the sixth year there is a preponderance of lymphocytes. Sex makes no material difference until the fifteenth year. The blood-making organs of the infant are severely affected by disease. The infantile blood readily takes up myelocytes and nucleated cells (Zelenski-Cybulski).

**Leukocytosis.**—By this is meant an increase in the number of white corpuscles in the blood. It may be of two varieties—relative and absolute. A relative leukocytosis is more frequent in children than in adults. By the leukocytosis one may judge the nature of the reaction of the organism to bacteria or to the toxins in the blood elaborated by the bacteria concerned in the inflammation or infection. It may thus be seen that the reaction of the individual will depend upon two factors: (*a*) the severity of the infection and (*b*) the resistance of the individual. Of the two, the latter is more important. It is a fact that the most marked degree of leukocytosis is observed in a healthy, well-nourished child suffering from a severe infection; while, on the other hand, a feeble child suffering from the same infection will have a slight leukocytosis or probably none at all. The nature of the reaction depends upon the character of the inflammatory process. Leukocytosis is less marked in serous and more pronounced in suppurative processes, while in both instances it is highest during the stage of active exudation. In well-localized suppurative inflammations there may be no leukocytosis at all.

Leukocytosis is present in a great many pathologic conditions, and in some cases the explanation is wanting. A satisfactory division of leukocytosis is into the two groups: (*a*) *physiologic* and (*b*) *pathologic*. By the former is meant that which follows a meal or exercise or that which occurs in the newborn; by the latter is meant that which may occur after serious hemorrhage, malignant disease, and various inflammatory and toxic conditions. Japha has not been able to demonstrate a genuine leukocytosis of digestion in the bottle-fed infant, and Greger did not even find it regularly present in the breast-fed infant. If, however, a breast-fed infant was given cow's milk, there was an immediate occurrence of leukocytosis, and hence the opinion (Moro) that it is a reaction against foreign protein. Children show a more pronounced digestive leukocytosis than adults, occasionally the increase amounting to one-third of the total number of leukocytes.

The chief form of leukocytosis in children is the inflammatory type. This is especially noticeable in acute pneumonia, diphtheria, acute rheumatism, erysipelas, scarlet fever, tuberculous meningitis, and in suppurative conditions of the subcutaneous tissues, serous cavities, bones, joints, and viscera. In these conditions the increase is chiefly in the polymorphonuclear neutrophils.

In pertussis, hereditary syphilis, and certain diseases of the spleen there is a relative increase in the lymphocytes, while in leukemia, asthma, helminthiasis, and some forms of chronic skin disease there is an increase in the eosinophils.

There is usually no leukocytosis in typhoid fever, measles, r  theln, mumps, malaria, and uncomplicated tuberculosis not invading the meninges or serous surfaces. In the usual forms of gastro-enteritis leukocytosis is absent, while in "Finkelstein's alimentary food intoxication" it is pronounced.

### THE BLOOD IN DIFFERENT DISEASES

**Pneumonia.**—In this disease there is regularly a leukocytosis, and it is in this illness that the inflammatory leukocytosis has best been studied. The leukocytosis here is an expression of the resistance of the organism to the infection, and depends but little on the fever and the extent of consolidation (Ewing). In an average case the count may vary between 15,000 and 40,000 or 50,000, and but rarely reaches 100,000; although there are a number of cases on record with a count as high as this. A high count gives no idea of prognosis; it means that the protective forces are making a vigorous fight, but gives no hint as to which will win, they or the infection. Absence of leukocytosis is usually of bad import, and shows that the patient has low resistance; and a rapid fall with either a low or a high temperature is usually indicative of a loss of resistance on the part of the patient. The fall in the count begins just before, just after, or with, that of the temperature; this diminution usually corresponds to the change in temperature. If the count remains elevated, delayed resolution, empyema, or abscess should be suspected. The increase is mainly in the polymorphonuclear cells, which may vary from 60 to 90 per cent. of the total leukocytes. In pneumonia following pertussis the increase is chiefly in the lymphocytes. The absence of a leukocytosis in a strong, well-nourished child who is very ill is always strong presumptive evidence against pneumonia. The changes in the red cells and hemoglobin are those of a secondary anemia, depending on the duration of the disease and the resistance of the patient.

Leukocytosis is present in both forms of pneumonia in infancy and childhood, but is more marked in the lobar form, the number of leukocytes to the cubic millimeter being about twice as many as in the catarrhal types. There is marked leukocytosis in the fatal cases of both forms of pneumonia (Koplik).

**Empyema.**—Marked leukocytosis is almost invariably present with a high polymorphonuclear count—usually from 75 to 90 per cent. In cases of long standing there is often no leukocytosis, but the polymorphonuclear count remains elevated. In tuberculous effusions the count is usually low, with no increase in the polymorphonuclear count.

**Influenza.**—Uncomplicated influenza has no leukocytosis and frequently induces a leukopenia. Influenzal pneumonia ordinarily has a leukocytosis of from 15,000 to 20,000. To date no uniform conclusions have been arrived at concerning any characteristic differential count other than that of an ordinary pneumonia.

**Tuberculosis.**—In tuberculosis, in general, there exists a mild grade

of chlorotic anemia with little or no leukocytosis. The count is nearly normal, while the hemoglobin is somewhat reduced. In other cases there is a lymphocytosis, absolute or relative. If a secondary infection occurs, which is not infrequent in infants and young children, leukocytosis is the rule, and, in fact, Limbeck considers the presence of a leukocytosis sufficient guarantee of a secondary infection. In case of pneumonia the leukocytosis is as high as in the ordinary croupous pneumonia. Various observers are of the opinion that in incipient tuberculosis there is a slight increase in the eosinophils, and that, as the infection progresses, they diminish. From a series of 182 blood examinations of tuberculous patients Solis-Cohen concluded that an increase in the polynuclear count points toward an advance of the disease and vice versa. In tuberculous bronchial adenopathy and peritonitis, leukocytosis is absent, although in the latter Cabot reported an increase in the cell count in 14 out of 60 cases. Tuberculous meningitis regularly causes a leukocytosis, reaching at times as high as 50,000, while there is usually a polymorphonucleosis, in some instances as high as 90 per cent. of the total white cells. In bone and joint disease the leukocytes are normal or very slightly increased, and only during abscess formation or following operation is there an appreciable increase in the cell count.

**Typhoid.**—As in adults, there is a low white cell count, generally under 10,000. The lymphocytes are slightly increased, and there is usually a mild grade of anemia.

**Rheumatism.**—There is regularly a leukocytosis and a severe grade of secondary anemia.

**Peritonitis and Appendicitis.**—In the former there is a polymorphonuclear leukocytosis. This, however, is wanting in some cases of the severest type. In a series of 70 cases of appendicitis in children reported by Fowler in 1912, the average leukocyte count was 19,106, the average polynuclear, 79.7 per cent.; the highest leukocyte count was 48,200; the lowest, 8200; the highest polynuclear count, 92 per cent.; the lowest, 63 per cent.

**Meningitis.**—In cerebrospinal meningitis and in meningitis caused by the other pyogenic organisms there is regularly a leukocytosis with an increase in the polymorphonuclears. The leukocyte count is of no value in distinguishing the various forms of meningitis, since it is also present in the tuberculous form (Emerson).

**Poliomyelitis.**—Until a monograph on poliomyelitis by Draper, Peabody, and Dochez, of the Rockefeller Institute, was issued, a number of conflicting statements had been made concerning the blood findings in this disease. Previous to this clinical study by the above authors, Müller, in Germany, and La Fetra, in New York, had made the most extensive observations. The latter reported a leukocytosis between 13,400 and 20,600, while Müller found a leukopenia in the acute stage. Draper, Peabody, and Dochez tabulated their findings in 59 hospital cases, and came to the conclusion that in the preparalytic stage the counts varied within the normal, but that there was a tendency toward a leukocytosis. In the acute stage, in every case except one in which leukopenia existed, there was a marked leukocytosis, in several instances reaching as high as 30,000. In addition to this increase in the white cell

count they found a constant increase in the polymorphonuclears of 10 to 15 per cent. and a diminution of lymphocytes of 15 to 20 per cent. The other white cells showed no abnormalities. In view of these findings a definite leukocytosis with an increase in the polymorphonuclears and a corresponding diminution of the lymphocytes is additional evidence, when considered with other available signs, in favor of the disease in question.

**Diseases with Eosinophilia.**—*Asthma.*—In true bronchial asthma the eosinophils may be from 10 to 20 per cent. Cases have been reported with eosinophilia as high as 50 per cent. Holt gave 10.7 per cent. as the average in a series of cases examined in his clinics by Wile; the highest was 26 per cent. The presence of an eosinophilia serves to distinguish the attack from one of acute bronchitis or tuberculosis. The occurrence of an increase in the eosinophils apparently determines the asthmatic character in certain spasmodic attacks of the respiratory system in infancy.

*Eczema.*—There is no difference between the number of eosinophils in infancy and childhood and that in adult life. Occasionally an eosinophilia is noted in *pemphigus*.

*Parasites.*—Any parasite, from the harmless pinworm to the most malignant uncinaria, may cause eosinophilia. It is not always present, nor does its degree bear any relation to the severity of the infection or the danger of the parasite. The presence of eosinophilia in a child should always make one suspicious of intestinal worms. Amberg, in studying amebic dysentery of children, found a slight increase in the eosinophil count. The average number of these cells in parasitic diseases is from 4 to 10 per cent. of the total white cell count, but these figures may be exceeded. In not a few cases symptoms of pernicious anemia have been present, and a severe grade of secondary anemia may exist.

In one of our cases of trichinosis the eosinophil count was 72 per cent.

**Syphilis (Congenital).**—There is usually a relative increase in the mononuclear cells and a severe secondary anemia, while a case with a severe rash, especially involving the face, may develop an eosinophilia as high as 23 per cent., diminishing as the condition improves.

**Gastro-enteritis.**—In this disease there is usually no leukocytosis, although in some cases a slight increase may be noted. It is remarkable that even in long-standing cases of gastro-enteritis and enterocolitis there is not a great reduction in hemoglobin.

In Finkelstein's food intoxication one of the cardinal signs is a leukocytosis of from 20,000 to 40,000, the largest cell percentage being of the polymorphonuclear variety.

**Acute Contagious Diseases.**—*Whooping-cough.*—In this disease the leukocytes are increased to three or four times the normal amount, averaging 40,000 (Emerson). The change is more pronounced the younger the child. The early appearance of a leukocytosis is important in diagnosis. The increase is chiefly in the lymphocytes, which may constitute from 60 to 80 per cent. of the total white count. A moderate eosinophilia may be noted.

According to Fröhlich and Muenier, the leukocytosis of pertussis far exceeds that of any other afebrile disease of the respiratory tract.

The leukocytosis occurs in the early part of the convulsive stage, disappears with improvement, and does not seem to be influenced by complications.

*Measles.*—Hecker recorded the results of his blood examination of 14 children. In the incubation period his observations were uniform, and he concluded that during the incubation period, and occasionally extending into the eruptive period, there existed—(1) a leukopenia; (2) a relative lymphocytosis; (3) reduction in the number of eosinophils. In 13 cases in the prodromal period Platinger found a neutrophil hyperleukocytosis of even 20,000, which rapidly gave place to a hypoleukocytosis during the eruptive stage. According to Holt there is a leukocytosis of 15,000 to 30,000, beginning soon after infection and increasing for four or five days. A marked increase in the leukocytes during the illness usually points to a complication. Hektoen, in his animal experimentation and observation on human beings, found that there was a preliminary leukocytosis, followed by a leukopenia, chiefly of the polymorphonuclear neutrophils, the lymphocytes being relatively increased.

*Diphtheria.*—In this disease there is a moderate anemia, a loss of about 2,000,000 red cells at the time of defervescence (Emerson, Ewing). The reduction in the hemoglobin is usually proportionate to the reduction in the red cells. There is usually a slight leukocytosis, ranging, as a rule, from 10,000 to 15,000, but in severe cases the white cells may number 17,000 and, with complications, 30,000 (Emerson). The rise is in the polymorphonuclear cells. According to Engel, the myelocytes are increased, especially in the fatal cases, from 3 to 16 per cent. Morse has said, "The examination of the blood in diphtheria is of no practical clinical importance in diagnosis, prognosis, or treatment."

*Scarlet fever* produces little change in the red blood-cells, but does cause a slight anemia (Reckzan), the average drop being 1,000,000. There is uniformly a leukocytosis, beginning in the incubation period and continuing into convalescence (Emerson). The leukocytes vary from 10,000 to 40,000; in mild cases from 10,000 to 20,000; in moderate cases from 20,000 to 30,000; in severe cases from 30,000 to 40,000, while, according to Holt, the number may be as high as 75,000. The variation is according to the severity of the case. The increase is chiefly in the polymorphonuclear cells, which may constitute 85 to 98 per cent. of the total count, especially in severe and fatal cases. At first there is a complete disappearance of the eosinophil cells, and later a rapid increase (20 per cent.). The disappearance of the eosinophil cells during the course of the disease is a bad prognostic sign, and absence of leukocytosis is also ominous.

In the *Centralblatt für Bakteriologie* of November, 1911, Döhle reported, in 30 cases of scarlet fever, certain inclusion bodies found chiefly in the leukocytes. More recent work by Nicoll, of New York, and Kolmer, of Philadelphia, showed that these bodies were present in streptococcus infections, and the latter observer reported their presence in 42 per cent. of diphtheria cases. The inclusion bodies are present in 94 per cent. (Kolmer) of scarlet fever cases during the first three days; after this they diminish in number, and are generally absent after the ninth day. Thus, while their diagnostic value is necessarily limited, their presence has

been considered useful in the differential diagnosis of scarlet fever, r  theln, measles, and gastro-intestinal rashes.

**Congenital Heart Disease.**—Of congenital affections, this disease presents the largest number of cases of polycythemia, although, as Osler stated, "polycythemia is not a constant feature in congenital cyanosis. It is characteristic rather of the latter stages of the disease, and its appearance is said to be of unfavorable prognosis." Vaquez and Quiserne stated their belief that when the polycythemia reaches 6,000,000 it seems to be fatally progressive, evidencing a more and more insufficient a  ration, the prognosis becoming correspondingly graver. The red cells frequently reach 6,000,000 to 7,000,000, and the percentage of hemoglobin may be as high as 160, and the specific gravity 1070; naturally the blood-clot is greatly increased, owing to the excess of red blood-cells. Cautley reported a case of polycythemia of 10,000,000, and Still, one of 9,280,000. The white blood-cells are not increased.

### BLOOD-PRESSURE IN CHILDREN

During the past few years numerous observations of the blood-pressure in different diseases have been made by Rolleston, Sergeant, and Hutinel, abroad, and by Howland and Hoobler in America.

A simple and easily handled machine of the Riva Rocci type is the Faught, with a cuff made from an ordinary Voorhees uterine dilating bag. With this combination the smallest arm can be readily accommodated. An exact estimation of the pressure is not always possible on account of the small size of the radial artery and the overlying thick pad of fat, which makes palpation rather difficult, and especially so when an infant struggles, as is not infrequently the case.

According to Kolossowa, Oppenheimer, and Bauchwitz, the following figures may be considered normal for systolic pressure:

Age, years.	Mm. of mercury.
1-2.....	75-85
3-4.....	85
5-7.....	90-95
8-10.....	95-100
11-13.....	100-110

The diastolic pressure during infancy is about 45 to 50 mm. of mercury and rises slowly and gradually until puberty, when it maintains a fairly constant level at about 60 mm.

The pulse pressure in infancy is 18 to 20 mm. of mercury, gradually increasing to about 30 mm. at three years of age. After ten years the pulse pressure is that of the normal adult, viz., about 40 mm. of mercury.<sup>1</sup>

Faber and James<sup>2</sup> have shown that there is no significant difference between the mean systolic pressures of the two sexes between the ages of three and seventeen years. However, the mean diastolic and pulse pressures show much greater standard deviations or normal variability in adolescent girls.

All febrile diseases tend to lower the blood-pressure. Comby, Hutinel,

<sup>1</sup> Wiggers, Carl J., *Circulation in Health and Disease*, 1923, 2d ed., pp. 361, 362.

<sup>2</sup> Amer. Jour. Dis. Child., vol. 22, p. 7, 1921.

and Rolleston have found a constant hypotension in scarlet fever and diphtheria, more pronounced in the former. These authors considered a severe degree of hypotension to be of bad omen, especially in scarlet fever, and they believed that this condition should be met by the exhibition of adrenalin hypodermically.

Among other causes of hypotension Janeway enumerated hemorrhage, collapse, and the action of poisonous drugs, especially chloroform. Hypotension is also met with in the diarrheas and in bronchial asthma.

The value of blood-pressure estimation in epidemic meningitis during intraspinal injections of serum will be referred to later.

Increased blood-pressure is observed in conditions of acute cerebral compression and anemia and in acute nephritis complicated by uremia.

### COAGULATION TIME

The great diversity of opinion on the normal coagulation time and that in various diseases has no doubt been due to the variety of instruments employed. Dependable results obtained are those of Rudolf (8.1 minutes) and Carpenter (9.5 minutes) working with different instruments.

It has been definitely shown that ordinary surface puncture gives variable results, depending on the depth of puncture, temperature, air-currents, dust, etc.<sup>1,2</sup>

Owing to these wide variations, despite careful technic and regulation of apparatus, no constant results have been obtained. From a rather exhaustive study Carpenter and Gittings concluded that it is improbable that any important variation exists in the coagulation of the blood in diseases other than of the so-called hemorrhagic type.

Rudd<sup>3</sup> has shown that there is normally an increase in the coagulation time of newborn infants (about seven minutes), which reaches its maximum on the fourth or fifth day. This is the period of greatest incidence of hemorrhagic disease of the newborn. From the fifth day on there is a gradual decrease in coagulation time, till by the tenth day it lies within ordinary normal limits.

In general, the bleeding time, three and a half to four minutes, follows the curve of the coagulation time.

As a general rule, average differences of one, two, or three minutes can hardly be construed as of any practical importance, inasmuch as a difference of from five to twelve minutes has been found in typhoid fever by authoritative observers.

### SIMPLE ANEMIA

Simple anemia is usually a secondary condition, and is not at all infrequent in children. A vast majority of the cases coming under our observation are those of children of the runabout age, and older children who are suffering from tardy malnutrition, having been badly fed and having wasted their energy in different ways. Simple anemia may be the result of hemorrhage, as in hemorrhagic disease in the newborn

<sup>1</sup> Lee and White. Amer. Jour. Med. Sci., 145, 495.

<sup>2</sup> Lee and Vincent, Arch. Int. Med., 13, 398, April, 1914.

<sup>3</sup> Amer. Jour. Dis. Child., vol. 19, p. 269.

and in purpura, particularly purpura fulminans (Henoch's). In the average case of anemia the hemoglobin ranges from 40 to 50 per cent., and the red cells from 3,500,000 to 4,000,000. Children suffering from tuberculosis and syphilis usually show a secondary anemia. It is also temporarily present after pneumonia, scarlet fever, diphtheria, and typhoid fever, and similar diseases which have severely taxed the organism.

A great many cases develop in runabout children under three years of age, for whom the milk diet has been continued as the almost exclusive means of nourishment. Children of the poor, because of the defective feeding and housing, are frequent sufferers.

**Symptoms.** The chief symptom is that of lack of endurance. The appetite is usually indifferent and the bowels are constipated. Such children tire readily, and are unable to keep up with their fellows at play or in school. They sleep poorly and, as a rule, are irritable and unhappy. In appearance they are apt to be pale and thin, although this is not invariably the case, as severe anemia is repeatedly observed in plump children.

*Illustrative Case.*—A very pronounced case was that of a boy of six years who weighed 46½ pounds. The blood examination showed: hemoglobin, 18 per cent.; red cells, 660,000. In two weeks the hemoglobin was 20 per cent.; the red cells, 640,000. Five weeks after first examination the hemoglobin was 30 per cent.; red cells, 1,172,000. The blood examination was checked up by a second person. No further improvement had taken place after one year of treatment. It seemed impossible without transfusion to raise the blood above 30 per cent. hemoglobin and 1,500,000 red cells.

Anemic murmurs may be heard over the heart, but this has been unusual in our cases. In the case referred to the heart sounds were normal. The spleen is not often found enlarged.

Examination of the blood in this condition of anemia enables one to estimate with accuracy the severity of the process. In mild cases there may be only a reduction in hemoglobin, and the blood may assume the chlorotic type. There is, in addition, a reduction in the specific gravity, depending on the degree of anemia, and if the primary affection, like pneumonia, causes an increase in the leukocytes, there will be a leukocytosis. In the cases of moderate severity the red cells may range between 3,500,000 and 4,000,000, and the hemoglobin from 40 to 60 per cent. In severe cases the red cells vary from 2,000,000, or a little less, to 3,000,000. There is a corresponding reduction in the hemoglobin. The more marked the reduction in red cells and hemoglobin, the more marked will be the poikilocytosis and polychromatophilia, and the greater the number of normoblasts and megaloblasts. In the severe cases myelocytes may be present. There is no increase in the eosinophil cells. In the severe secondary anemias the physical characteristics of the blood are very striking. It may be so thin as to separate on puncture into a reddish and a colorless portion resembling beef-water (Koplik).

The **prognosis** is good in the cases in which syphilis and tuberculosis are absent. In fact, the majority of cases respond most satisfactorily to properly directed treatment.

**Treatment.**—The management consists in placing the child in a normal child's environment, which includes the giving of suitable food.

The treatment described under Tardy Malnutrition (p. 147) covers these cases.

In pronounced cases transfusion offers the most prompt results.

*Management of Secondary Anemia Through Blood Transfusion by the Lindemann Method.*—Signally satisfactory results have been obtained by this method of treatment. Infants with hemoglobin under 25 per cent. (Dare) and red cells under 2,500,000 have been permanently cured by one transfusion. So satisfactory have been the results that we now employ transfusion in all cases that fail to make a reasonably satisfactory response to other measures.

The following table gives in a concise manner the results of transfusion in 8 cases:

BLOOD BEFORE TRANSFUSION								BLOOD AFTER TRANSFUSION				
Sex.	Age, months.	Weight.	Hgl. per cent.	R. B. C.	Amount transfused, c.c.	Hours after.	Hgl. per cent.	R. B. C.	Months after.	Hgl. per cent.	R. B. C.	Weight.
F.	12	12.5	Sahli 14	2,400,000	175	24	Sahli 45	5,120,000	17	Fleischl 70	4,600,000	26 1/2
F.	18	24.0	Sahli 37	3,900,000	200	24	Sahli 35	5,760,000	14	Fleischl 90	5,000,000	22.0
M.	12	16.4	Sahli 32	4,480,000	300	24	Sahli 78	5,150,000	3 6 12 18	Dare 60 52 63 65	3,840,000 4,400,000 5,000,000 5,000,000	16 1/2 17 1/2 18 1/2 19 1/2
F.	23 24	15.10 16.7	Sahli 20 30	2,800,000	140 200	24 24	Sahli 55 90	3,100,000 4,320,000	1 7	Dare 37	2,700,000	16 1/2 19 1/2
F.	6	11.0	Sahli 37	1,600,000	150	24	Sahli 85	4,000,000	7	Dare 65	4,800,000	19.5
M.	10	12.5	Dare 33	4,300,000	200	24	Dare 58	4,900,000	1	Dare 58 Died of lister. mal. good.	5,000,000 meningitis, 3 mo. Blood count nor- mal, general condition	12.8
F.	12	12.4	Sahli 35	3,120,000	170	24	Sahli 62	4,040,000	1 3 6	Dare 50 50 56	5,320,000 4,100,000 4,400,000	14.0 17.4 19.5
M.	16	21.0	Sahli 35	3,300,000	200	24	Sahli 55	3,400,000	1	Dare 60	4,500,000	24.8
									6	Fleischl 55	4,100,000	25.12

### CHLOROSIS

Chlorosis is a form of anemia most frequently seen in young girls at the time of puberty or later. Exceptionally cases showing the typical blood-picture of chlorosis are found in very young children.<sup>1</sup> The cause of the condition is not known. Various theories have been advanced, none of which can be proved. The most plausible theory assumes the existence

<sup>1</sup>J. P. C. Griffith, Types of Anemia as Seen in Early Life. Medical Clinics of North America 4, 1125, January, 1921.

of a persistent intestinal intoxication. That such is a probable cause has been suggested in numerous cases. The more pronounced changes occur in the specific gravity of the blood, and correspondingly in the hemoglobin, both of which are reduced out of proportion to the reduction in red cells, although in severe cases the red-cell count may fall to 1,000,000. In ordinary cases the corpuscles vary between 3,000,000 and 4,500,000, while the hemoglobin may be as low as 30 per cent. There is no leukocytosis, but microcytosis, poikilocytosis, and polychromatophilia are usually present. Occasionally a few normoblasts are found.

**Symptoms.**—The symptoms are quite characteristic. The patient is habitually tired and incapable of unusual or prolonged exertion. The skin is of a peculiar sallow, greenish color. The hands and the feet are cold. Amenorrhea is almost always noted in girls who have passed the period of puberty. The menses may be discontinued for a year. The appetite is capricious, and the patient craves most unsuitable articles of food and substances not in the food class. The history usually includes the story of habitual constipation which was never treated.

Anemic heart murmurs and the venous hum over the vessels of the neck are usually present. The patient is nervous, irritable, and not infrequently hysterical. A pronounced case of hysterocatalepsy was established in one young girl with chlorosis.

**Prognosis.**—While this condition is usually obstinate, the outcome in our cases has always been favorable.

**Treatment.**—The management consists in the correction of the constipation and in the provision of suitable food at definite intervals. Eating between meals must not be allowed. Stress, both physical and mental, is to be avoided. Iron and arsenic are of value. The following combination of drugs has served well:

R. Strychninæ sulphatis.....	gr. 1/4
Acidi arsenosi.....	gr. 1/5
Extracti ferri pomati.....	gr. vj
Extracti cascariæ sagradæ.....	gr. xxx
Quinina bisulphatis.....	gr. lx
M. ft. capsulæ No. xxx.	
Sig.—One after meals.	

The amount of cascara prescribed depends upon the degree of constipation.

After the diet and the bowel habit have been satisfactorily adjusted, the patient should be given a change of environment. Nothing is so conducive to a reasonably prompt cure as an absolute change in the daily life of the patient.

Entertainment and amusements which do not excite or overtax are to be encouraged. The cure will be aided by removal of the patient from association with persons who are not congenial.

## PSEUDOLEUKEMIC ANEMIA OF VON JAKSCH

In this affection there is marked anemia with enlargement of the spleen. The condition was first described by von Jaksch, who believed it to be a clinical entity. The disease represents an unusually severe

type of secondary anemia, and is of toxic origin, although the nature of the toxemia is not understood.

There are no valid grounds for believing so rare a disease to be dependent upon rachitis or syphilis. Syphilis and rachitis occur with the greatest frequency. If these diseases were causative factors, it is reasonable to suppose that there would be many more cases. The great majority of the cases occur in children under three years of age and follow prolonged intestinal disturbance and malnutrition.

**Pathology.**—The pathologic changes comprise enlargement of the spleen and moderate swelling of the lymph-nodes, with a diminution in the specific gravity, the hemoglobin, and the number of red cells in the blood, and an increase in the leukocytes. The liver is at times slightly enlarged and the lymph-glands may show moderate hyperplasia.

**The Blood.**—The number of red cells is frequently as low as 2,000,000. It may fall to 800,000. The color index is low. The hemoglobin reduction is very great, and may reach 30 per cent. (Emerson, Comby, Cautley). There is always a leukocytosis of from 20,000 to 50,000. In one case reported by Emerson the leukocytes numbered 114,000, and in another, at the Babies' Hospital, 96,000. They may show an increase in the mononuclear or polynuclear forms. The eosinophils are usually increased, but may be normal or diminished. The white cells exhibit great variety in size, shape, and staining properties. Mast cells and myelocytes in small numbers may be found. Karyokinesis is common, and is regarded by some observers as of diagnostic importance (Comby). The red cells include many microcytes, myelocytes, normoblasts, and megaloblasts, and show, in addition, poikilocytosis and polychromatophilia.

The blood-picture is indicative but not diagnostic of the disease.

**Symptoms.**—The symptoms are those of progressive, pronounced anemia in a child fairly well nourished. Emaciation may develop later in the disease. The patient becomes very weak and his activities cease.

The appetite is often greatly impaired, and food, if urged, is apt to be vomited. In the later stages hemorrhages from the mucous surfaces may occur. Petechiæ are common. The lymph-nodes show moderate enlargement.

Fever is occasionally present, usually due to abnormal intestinal conditions.

Cabot emphasized the point that the many very different cases thus diagnosed cannot be grouped together.

**Diagnosis.**—In von Jaksch's anemia the splenic enlargement exceeds that ordinarily found in rickets and in syphilis. In pernicious anemia the leukocytes are not increased and the spleen is not enlarged as in pseudoleukemic anemia. Other forms of leukemia are distinguished by the blood findings. Banti's disease occurs in later childhood.

**Prognosis.**—The prognosis is very unfavorable. Death in the fatal cases takes place from intercurrent disease. Patients who exhibit improvement for a time usually succumb later.

**Treatment.**—The management is entirely supportive. Iron and arsenic may be given in the hope that they will be of some benefit.

## LEUKEMIA

Leukemia is a disease marked by the constant presence in the blood of granular mononuclears, or an increase in the blood of the non-granular cells with round nuclei—the miniature cells of the blood-building organs, which are not normally present in the peripheral circulation. There is also a decided change in the blood formula. Generally there is a marked increase in the leukocytes, and yet there are instances when the count is normal and the diagnosis is made from the increase of abnormal cells.

*Spleno-myelogenous Leukemia.*—In this disease there is a great increase in the granular cells, more especially the myelocytes, eosinophils, and basophils, and also in the cells with spheric or slightly indented nuclei (Emerson). The total blood is increased in the majority of instances and diminished in few. In a great many cases the blood may appear to the eye normal; in extreme cases it is pale, opaque, and flows sluggishly.

The red cells are greatly reduced in number—occasionally as low as 2,000,000. Poikilocytosis is present in all cases; microcytosis and macrocytosis are rare, while polychromatophilia is usually present.

This is the condition par excellence in which normoblasts are present in abundance. In many cases megaloblasts are found. The hemoglobin is much reduced.

The white cells vary from 100,000 to 500,000 (Holt), or, as mentioned before, may be normal in number. Neutrophils are absolutely diminished, but relatively increased. The lymphocytes are increased, but vary according to the stage of the disease. Eosinophil myelocytes are found, and there is an absolute increase in the eosinophils. Ehrlich stated that in this disease there is always an increase in the basophils. Cornil's myelocytes are also present.

*Lymphatic Leukemia.*—In the lymphatic type there is a marked increase in the mononuclears. Despite the name, the increase is not always in the lymphocytes, although this increase is most usually in the small mononuclears, which in some cases have been known to form 97 per cent. of the total white cells. Polymorphonuclears are rare. Eosinophil cells are noticeably absent, and in a pure case myelocytes are not present. It is important to note that in children the total white cell count may be normal or slightly above normal in this disease. The abnormal preponderance of the mononuclear cells is the criterion for diagnosis from the stained smear. There is a greater anemia in this form than in spleno-myelogenous leukemia. In the acute type of lymphatic leukemia coagulability of the blood is greatly diminished.

In a review by Churchill (1904) the lowest red-cell count reported was 750,000 after a severe hemorrhage, and the leukocytes varied from 6000 to 810,000 (in a twenty-month-old child). In a case reported by Wollstein from personal observation there were 99 per cent. of small mononuclears, many of which were degenerated.

**Etiology of Leukemia.**—Leukemia is rare in childhood, although it may occur in infancy, and according to Ewing<sup>1</sup> is "a disease of early years when the blood-forming organs are relatively active." The cause is unknown.

<sup>1</sup> Neoplastic Diseases, p. 366.

**Morbid Anatomy.**—The bone-marrow is always changed in acute lymphatic leukemia it is red or gray, with an increase in the lymphocytes. In myelogenous leukemia the marrow is red, grayish, white, or greenish, with an increase in the myelocytes.

The *spleen* is enlarged in all forms of leukemia, and may be enormous in size. Typically the greatest enlargement occurs in cases of the splenic-myelogenous type.

*Adenoid tissue* throughout the body is hyperplastic.

The *liver* is enlarged, and contains many small grayish or yellowish areas which are collections of leukocytes.

The *lymph-nodes* are always enlarged in lymphatic leukemia, and may be enlarged also in the myelogenous form. The cervical, axillary, and inguinal nodes may form masses as large as an egg or even larger. These masses are soft, painless, and not adherent to the skin.

*Leukemic infiltrates* or *lymphomata*, circumscribed or diffuse, consisting of masses of lymphocytes, may be present in the kidneys, lungs, skin, peritoneum, dura, myocardium, pancreas, etc.

*Hemorrhages* from the gums and the nose and into the subcutaneous tissues may occur. In acute lymphatic leukemia this feature is not unlike that characteristic of purpura.

**Symptoms.**—To a considerable degree the symptomatology may be inferred from the description of the blood characteristics and morbid anatomy of the disease.

In the rare *myelogenous leukemia* the onset is insidious. Glandular enlargement may not be evident at any stage or at most be very slight. Weakness, anemia, splenomegaly, or sudden hemorrhage from any of the mucosæ may constitute the initial symptoms. With the progress of the disease, petechiæ or ecchymoses in the skin appear, gastro-intestinal disturbances occur, and irregular and intermittent fever is noted. There is marked weakness and prostration. Leukemic plaques may be found on retinal examination. The enlargement of the spleen may attain tremendous proportions. The urine may show albumin and casts. Edema of the lower extremities or generalized dropsy is frequently a terminal event. The course, although comparatively rapid as compared with that observed in adults, does not usually bring about a fatal issue as quickly as the true lymphatic type.

*Illustrative Case.*—A boy, four years of age, weighing 33 pounds, was referred by Dr. Brooke, of Bayonne, N. J. For nine months there had been a gradual abdominal enlargement, with pallor and gradually increasing weakness. The spleen was enormously enlarged, extending to 1 inch above the pubes and 1½ inches to the right of the umbilicus. Examination of the blood showed: Hemoglobin, 35 per cent.; red blood-cells, 2,000,000; white blood-cells, 760,000; myelocytes, 61 per cent.; polymorphs, 41 per cent.; lymphocytes, 10 per cent. Benzol. in 2-minim doses in emulsion, three times daily, was given for six weeks, at which time the boy showed marked improvement. The appetite was much better. He was more active. The general appearance was decidedly better. The spleen had appreciably decreased in size. The blood examination showed that the general betterment was consistent: Hemoglobin, 48 per cent.; red blood-cells, 3,728,000; white blood-cells, 272,000; myelocytes, 27 per cent. After three months the child failed rapidly, however, and died in another city without later blood examination.

*Acute lymphatic leukemia* is rapidly fatal. The onset may be sudden, with weakness, pallor, prostration, fever, muscular pains, and sore throat.

or the disease may come on gradually with temporary remissions and relapses. The glandular enlargement is usually the first objective sign. With the adenitis there occurs enlargement of the liver and spleen and multiple hemorrhages into the skin and mucous membranes, varying in size from small pin-point petechiae to extensive ecchymoses. These are especially common in the buccal mucosa where ulcerations may develop. There is ultimately a high fever which may maintain a fastigium or may fluctuate. The weakness and prostration become progressive.

A fatal termination within ten days of the onset is not exceptional and a course of two months' duration is rare. The blood-picture in severe cases may remain constant, or in milder cases may show irregular remissions.

*Atypical forms of leukemia* are observed in which there may be no leukocytosis or even a leukopenia; other cases in which enlargement of the spleen is extreme with a preponderance of lymphocytes in the blood; and still others in which myelocytosis accompanies leukopenia. By some observers von Jaksch's disease has been regarded as a leukemia peculiar to infancy.

**Prognosis.** The prognosis is most unfavorable. Few patients survive one year of the disease. Reported recoveries probably mean errors in diagnosis. Death usually takes place from intercurrent disease.

**Treatment.**—Nutritional measures should be brought into use. Iron, arsenic, and cod-liver oil are usually employed. Dr. Frank Billings, of Chicago, reported benefit in 5 adult cases treated with benzol. Our own observation with benzol has been as unfavorable as with other methods of treatment. True, it does temporarily reduce the number of white blood-cells, but in children the total white count may not be high.

The use of x-ray over the spleen and the long bones appears to be of temporary benefit, reducing the blood-count and causing remissions, but the outcome remains the same. The intravenous use of active deposit of radium has not yet reached the stage where it will bear discussion. Radium does reduce the white count markedly, and simultaneously to a moderate degree the number of red cells, but the method is at present fraught with danger.

Transfusion, although of very little benefit, possibly tends to counteract multiple hemorrhages.

### PERNICIOUS ANEMIA

Pernicious anemia in infants and young children is very rarely seen. In fact, its existence in children has been questioned, for blood states described as peculiar to pernicious anemia have been found in other diseases, as in rachitis and syphilis, in which there is extreme anemia. On the other hand, cases of primary pernicious anemia have been reported by observers of repute sufficiently often to establish the disease as an entity.

**Lesions.**—In pernicious anemia there is extreme general pallor, and fatty degeneration of the heart muscle, the liver, the pancreas, the gastrointestinal epithelium, and the kidneys. In addition, hemosiderosis is present in the liver, spleen, bone-marrow, and kidneys due to the destruction of red blood-cells. Capillary hemorrhages into the viscera are rarely lacking, and are especially frequent in the nervous structures and in the

serous membranes. The color of the bone-marrow may be changed from yellow to red, and microscopically shows many megaloblasts.

**The Blood.**—The specific gravity and coagulability are much reduced, and the hemoglobin may be as low as 20 per cent. The red corpuscles show a proportionately greater reduction in number, so that the color index of the blood is high. In the fresh specimen rouleaux formation is absent, and the cells vary much in size and shape, extreme poikilocytosis being the rule. A large increase in the megakaryocytes, with absence of microcytes, is very suggestive of the disease in question. Owing to the relatively high content of hemoglobin the red cells stain fairly well and uniformly, but in many cases there is a degeneration with accumulation of hemoglobin in the center of the cell. The megakaryoblasts usually outnumber the normoblasts.

In severe and uncomplicated cases there is always a leukopenia, and the polymorphonuclear count is roughly parallel to the leukocyte count. Myelocytes are usually present.

**Symptoms.**—The symptoms are those of rapidly progressive, high-grade anemia. The chief symptoms are pallor and marked exhaustion. The patient is intensely prostrated, and a gastro-intestinal crisis typically develops. Emaciation is not of constant occurrence. Petechiæ and submucous hemorrhages occur. The duration of the disease is but a few months, and the true cases are fatal.

**Treatment.**—Foci of infection possibly contributing to blood impoverishment should be diligently searched for and eradicated, and all the general measures employed to improve nutrition and vitality should be instituted.

Transfusion is often of great temporary benefit and should not be postponed for long in order to have the maximum good effect. Unfortunately, even repeated transfusions in true pernicious anemia ultimately fail in effect.

### PURPURA

By purpura is understood a condition in which the blood, with no constant change in its character or demonstrable lesion in the vascular walls, either escapes spontaneously from its natural channels and constitutes a free hemorrhage, or becomes localized in different portions of the skin and subcutaneous tissue.

*Simple purpura* occurs in the form of petechiæ, often as a terminal symptom in exhausting diseases. It may result from severe vascular strain, as in pertussis. Several such cases are recalled. Purpura is a prominent symptom in scorbutus and pellagra rheumatica. It may occur as a direct effect of poisonous drugs. Thus in the writer's own cases it has resulted from accidental large dosage of phosphorus and antipyrin. In a vast majority, if not all, of the cases the condition is due to toxic substances originating within the body or introduced from without.

**The Hemorrhagic Type.**—The distinction between simple and hemorrhagic purpura is largely one of degree. In the hemorrhagic type there are free hemorrhages from different portions of the body, usually associated with extensive subcutaneous hemorrhage or hemorrhages into different organs. Massive hemorrhages have been designated as *purpura fulminans*, or *Hemol's purpura*, and here again the differentiation is based upon the severity of the condition.

In that form of hemorrhagic disease termed *pseudohemophilia*, *thrombocytopenic purpura*, or *Werlhof's disease* there is consistently found a diminution of blood-platelets, prolonged bleeding time, and lack of normal clot retractility without diminution in actual clotting time. A diseased state of the capillaries combined with an abnormal and excessive blood-platelet destruction by the spleen are given as factors in the pathogenesis of these persistent cases.

*Illustrative Cases.*—One patient two years of age developed a mild purpura while taking large doses of antipyrin, which was being administered as the result of a misunderstanding.

In *pyemia purpura* is not unusual. In a patient nineteen months of age, who died from a septic sinus thrombosis with extension to the jugulars, there was extensive purpura for forty-eight hours before death. Blood examinations made from this patient during life showed pure cultures of streptococci.

Another patient, a boy eight years of age, previously healthy, died in three days from *purpura fulminans* (Hemochl). Death resulted from extensive hemorrhages under the skin, combined with hemorrhages from the nose, mouth and intestines, and presumably the viscera. An autopsy was not allowed. In this case also blood-culture made postmortem from subcutaneous hemorrhagic areas showed pure growth of streptococci.

A notable case was that of a boy seen in consultation with Dr. Corwin, of Rye, N. Y. The family history was negative. The tonsils and adenoids were removed six months before the illness, without more than the usual bleeding. Two months before the illness the boy fell and broke off an incisor tooth. No bleeding followed the accident. On June 15, 1910 the patient was taken ill with tonsillitis. The temperature ranged from 100° to 102° F., and continued for one week. During this time numerous subcutaneous hemorrhages appeared at various sites over the body, particularly on the leg. A large hematoma developed in the abdominal wall. There was some bleeding from the gums, and the subcutaneous hemorrhages continued to appear on the chest, abdomen, and legs. There was moderate bleeding from a bicuspid tooth. The child was given calcium lactate in small doses, 3 grains every three hours. The hemorrhage from the gum stopped, and the subcutaneous hemorrhages began to show signs of absorption.

On July 7th, a little over two weeks after the first sign of the purpura, there was a hemorrhage from the nose which lasted about an hour. On the following day there was another hemorrhage from the nose which lasted five hours, resisting all ordinary methods of control. The patient, who was at this time seen by the senior author, evidently had suffered much from loss of blood. The eyes were sunken and the skin was pale and sallow and showed in many areas the evidences of the previous subcutaneous hemorrhage. The child was markedly prostrated. Calcium lactate was resumed in 10-grain doses every two hours. On account of the greatly reduced condition of the patient normal salt solution was given by the drop method through the tube introduced into the colon. The stools at this time consisted largely of coagulated blood.

July 9th the hemorrhage appeared to be controlled. Twenty grains of calcium lactate were given every two hours.

July 10th nasal hemorrhage began at 5 A. M. and continued for five hours. Saline irrigation returned blood-stained. The child was now in an extreme condition, and 30 c.c. of human serum were injected subcutaneously by Dr. J. E. Welch. During the remainder of the day from 45 to 60 c.c. of the human blood-serum were injected at two-hour intervals until midnight. The amount injected in twelve hours was 290 c.c. In the evening there was an evacuation of the bowels, composed entirely of coagulated blood.

July 11th the stools contained blood, and the expectoration contained some bright red blood. There was a moderate nasal hemorrhage. At 8 A. M., 3 P. M., and 9 P. M. a total of 167 c.c. of human blood-serum was given in three doses.

July 12th there was no visible hemorrhage from any portion of the body. Four injections of the blood-serum were used, the total amount being 191 c.c.

July 13th, 14th, and 15th three injections of the blood-serum were given at about six-hour intervals, in quantities ranging from 20 to 30 c.c.

July 16th two injections of the serum were given at twelve-hour intervals—44 c.c. in all—and on July 17th one injection of 35 c.c. was given. The total amount of serum given during the one week of treatment was 1034 c.c.

From this time the child manifested a slow but steady improvement, and eventually made a perfect recovery. It was of interest to note that the hemorrhage, which

had continued intermittently for nearly three weeks, ceased within fifteen hours after the first injection of human serum. While the treatment with the serum was being carried on the child was kept alive by predigested foods and free stimulation.

For obvious reasons a blood-culture was not made, although quite possibly, there was a bacteremia with resulting blood changes which the human serum was able to control.

**Diagnosis.**—Little difficulty is ordinarily encountered in the recognition of this disease, although a differentiation of the particular type occurring in a given case may be difficult. A particular point to be kept in mind is the possibility of confounding Henoch's purpura with intussusception. In the former abdominal pain is severe and intraperitoneal extravasations of blood may give rise to surgical signs. Such cases have undergone operation, repeatedly, and it is questionable whether in the event of inability to make a positive diagnosis exploratory laparotomy is not the only procedure to be followed.

**Prognosis.**—The prognosis in the simple cases is good. The phosphorus-poisoning case was fatal, but not alone owing to the hemorrhage. In hemorrhagic cases of severe type the outcome appears to depend upon the promptness with which human serum is introduced into the circulation. The appearance of purpura in serious or prolonged diseases is a very unfavorable sign.

**Treatment.**—The treatment of the milder cases is that of the disease with which the purpura is associated. An effort should be made to establish the vitality and resistance of the patient by removal, when possible, of the cause of the condition, and by the administration of acids and fruit juices. The use of ergot and suprarenal extract has not been of appreciable service. Calcium lactate has appeared to be of some value in cases not severe. Twenty grains should be given every two hours.

**Specific Treatment.**—As a means of prompt relief human blood far exceeds in value all other agents. It may be used in the form of serum, as in the case referred to. From 2 to 4 ounces should be given daily until the hemorrhage is controlled. (See Hemorrhagic Diseases of the Newborn, p. 182.) Injections of whole blood have repeatedly proved of similar benefit.<sup>1</sup>

Transfusion possesses the greatest immediate restorative power, but apparently has no more curative value than the repeated intramuscular injections of whole blood.

**Splenectomy** has been performed in a few cases unrelieved by other measures, with brilliant results.<sup>2, 3, 4</sup>

### HEMOPHILIA (BLEEDER'S DISEASE)

By "hemophilia" is meant a constitutional tendency to uncontrollable bleeding, spontaneous or arising from wounds which in the normal individual occasion little or no bleeding at all.

**Etiology.**—Isolated cases of hemophilia are not unknown, but there is no doubt that the family histories of these patients are defective. It is more usually the case that the bleeding tendency is known in the family,

<sup>1</sup> Dixon, Brit. Med. Jour., 1, 16, 1923.

<sup>2</sup> Kaznelson, Wien. klin. Wchnschr., 1916, 29, 1451.

<sup>3</sup> Brill and Rosenthal, Amer. Jour. Med. Sci., October, 1923, 503.

<sup>4</sup> Bowen, Bull. Buffalo General Hospital, 1, 1, 1923.

and that one or more of the child's ancestors has suffered from the complaint, or, where a "bleeder" has been born of healthy parents that one or more of the succeeding generations is affected.

The peculiarity of this condition lies in the mode of inheritance; the males of the family chiefly are affected, while the tendency is transmitted through the females. This law has occasional exceptions, the proportion of female to male bleeders being about 1:12 (Rachford). The mode of inheritance is not unique, for there is evidence that cases of partial albinism follow the same law (Nettleship), and it has also been observed in certain cases of color-blindness and night-blindness. These and other instances are examples which can be best explained by the Mendelian theory.

In a family of bleeders the female members transmit the disease and the males manifest it. Thus, a girl whose mother is a bleeder will not show signs of the disease, but will transmit the condition to her children, while her brother will be a bleeder himself and yet his children by a healthy wife will not be bleeders, although his grandsons, through his daughters, may suffer from the disease. The tendency to transmit hemophilia is no stronger in a woman from a family of bleeders, who herself is a bleeder, than in her sister, who may not be a bleeder. Marriage to individuals who are not affected is no means of preventing the condition. It is a curious fact that the disease has been found in large families.

The condition is rarely noticed at birth, but in most instances is recognized before the end of the second year has been reached. Before the tenth year it is almost always fatal and after the twentieth year the condition is very rare. Most of the cases observed have been among Germans and Jews, while the disease is practically unknown in the tropics.

**Pathology.**—In subjects who succumb the chief alterations are due to the draining of the blood from the organs. With this exception there is no constant anatomic change. There may be an endarteritis, fatty degeneration of the intima, and thinning of the vessel walls, making the arteries resemble the veins.

**Blood Changes.**—There is usually a slight decrease in the number of leukocytes, especially of the polymorphonuclear variety, and beyond this the changes are but transitory. Following a severe hemorrhage the red cells are promptly restored to their normal number, and the hemoglobin much more slowly, so that a simple anemia may be present for weeks following a severe hemorrhage.

The various observations recorded regarding the coagulation time are most conflicting and are probably due to the lack of uniformity of technic. Wright has shown that the coagulation time is much prolonged, while Sahli has considered it diminished in the interval and normal or increased during the height of an attack.

In spite of the general law that clot formation is defective, when coagulation has actually occurred the normal clot retraction takes place, in contradistinction to the condition seen in extreme and typical cases of purpura (p 447.)

Various hypotheses have been propounded to explain this abnormal tendency to hemorrhage, such as abnormal fragility of the vessel

walls (Virchow), increased blood-pressure (Immerman), a definite infectious process (Koch), while Sahli considered the essential feature an abnormal chemical alteration in the walls of the blood-vessels, which results in the failure of a substance (thrombokinase) which is essential to the formation of a clot.

**Symptoms.**—The first manifestations of hemophilia are not often seen before the second year. The hemorrhages of the newborn and of purpura have no relation to this condition. The most significant symptom is bleeding of a serious nature from slight injury or no apparent cause. There may be a severe sudden hemorrhage, or a constant oozing of blood which resists all attempts to check it. Such trivial injuries as the extraction of a tooth, or even dentition, may give rise to prolonged bleeding of a serious aspect. These hemorrhages, usually from mucous membranes, take place in the gums, nose, throat, or bowel. Effusion of blood into the joints may be chronic, with some limitation of motion and even ankylosis resulting. Following these hemorrhages ensue the symptoms common to hemorrhage from any cause, and if the case be fatal the patient dies from exhaustion. Sometimes death is preceded by or occurs during a convulsion.

**Prognosis.**—The prognosis is, on the whole, bad in childhood. Fully half of the hemophilic patients die before reaching their eighth year, and less than 12 per cent. survive to puberty (Littar v. Etlinger). The first hemorrhagic attack is rarely fatal.

**Diagnosis.**—The diagnosis of hemophilia must rest to a large extent upon a knowledge of the family history. Where there is no known "bleeder" in the pedigree, the diagnosis of hemophilia is always open to criticism. It must be remembered that there are other causes of repeated and obstinate hemorrhage than hemophilia, that, for instance, in recurrent idiopathic purpura, such hemorrhages are met with, and that effusion into the joint cavities occurs in both diseases. In hemophilia the effusion is bloody; in purpura it is invariably serous. In hemophilia, according to Pratt, there are about 450,000 platelets per cubic centimeter, whereas in purpura there are 50,000 or less. Blood examination rules out anemias and leukemias.

**Treatment.**—Prophylaxis is the most effective treatment. Marriage should be discountenanced. That such advice, however, is rarely followed out the records of the various "bleeder" families show. The patient should be guarded from birth against all operations unless they be of a life-saving nature, and then previous treatment with calcium lactate should be used, while at the time of operation blood-serum may be injected subcutaneously.

In the event of hemorrhage styptics should be employed, the most effective being tannic acid or the perchlorid of iron. No positive results are obtained from the administration of calcium lactate in cases of persistent epistaxis. Gelatin is of little service. In cases of severe hemorrhage blood transfusion should be resorted to, and if practicable the father's blood should be employed. Numerous cases are on record where this procedure has tided patients over critical periods. If transfusion is impossible, repeated injections of human serum or even horse-serum may be employed.

## XIV. DISEASES OF THE GLANDULAR SYSTEM

### THE SPLEEN

IN children the spleen is very rarely the seat of primary disease. Sarcoma, carcinoma, abscess, and cysts, with primary involvement of the spleen, have been reported. This organ, however, frequently shows secondary involvement and furnishes an important diagnostic sign in a large number of diseases. Thus the spleen is enlarged in syphilis, in rachitis, typhoid fever, in persistent intestinal infections, in malaria, in cirrhosis of the liver, in portal obstruction due to a neoplasm, in right heart failure, and in practically all the blood diseases of early life.

### SPLENOMEGALY

Usually the organ shows a simple enlargement, which subsides when the disease causing the condition is removed. As the result of repeated or persistent enlargement for a considerable time, as in malaria and some of the blood disorders, the gland undergoes hyperplasia and permanent enlargement.

Primary splenomegaly of the Gaucher type is of unknown origin. The probable cause is a chronic toxic agent, to which a family predisposition exists. (See page 453.)

Splenomegaly in infantile splenic anemia has been found to be associated with a parasite, *Leishmania infantum*, similar to the Leishman-Donovan parasite, which is the cause of kala-azar. The parasite was discovered in the infantile cases by Pianese and Nicolle.

Splenomegaly occurs in cases of septicemia, malaria, tuberculosis, syphilis, rachitis, leukemia, Hodgkin's disease, Banti's disease, and anemia infantum pseudoleukämica. In pernicious anemia the spleen is rarely very large.

Neoplasms (sarcoma, angioma, fibroma, cysts) of the spleen are very rare.

### SPLENIC ANEMIA (BANTI'S DISEASE)

Under the heading splenic anemia have been described by various writers Von Jaksch's anemia, Gaucher's disease, hemolytic icterus, certain forms of leukemia, and the combined splenomegaly and cirrhosis of the liver called Banti's disease. Gradually the various conditions have been differentiated until the term "splenic anemia," is now usually accepted as specific, including properly only Banti's disease. That this last affection *as recognized* actually represents a late stage of splenic anemia is considered probable.<sup>1</sup>

**Definition.**—Splenic anemia is a chronic disease of unknown etiology, characterized by splenic enlargement, anemia, hemorrhages, and ultimately hepatic cirrhosis and ascites.

**Etiology.**—The cause is unknown. Few cases are seen in the first decade of life. That syphilis is productive of the condition called Banti's

<sup>1</sup> Pool and Stillman, *Surgery of the Spleen*, 1923, D. Appleton & Co., p. 174.

disease is the view advanced by Norris, Symmers, and Shapiro.<sup>1</sup> This belief has not as yet received general support, probably due to the existence of negative Wassermann reactions in most cases of so-called Banti's disease.

**Pathology.**—The changes observed in the spleen consist chiefly in fibrosis with thickening of the capsule and trabeculae, reduction in the number and size of the Malpighian bodies as a result of the productive changes, and associated hyaline degeneration in the walls of arterioles. The bone-marrow shows the usual lesions characteristic of severe secondary anemia, with reduction in both the hemoglobin and the number of red cells. The leukocytes are often reduced in number, but show normal proportions of the various types of cells. The platelet count and coagulation time are not abnormal. The Wassermann reaction is seldom positive.



Fig. 79.—Banti's disease. The patient, a girl of ten years, presented icterus, ascites, and hematemesis. (Children's Medical Division of Bellevue Hospital.)

The liver in advanced cases undergoes atrophic cirrhosis of the Laënnec type and the splenic portal veins may undergo some degree of thickening.

**Symptoms.**—The first sign is, typically, gradual abdominal enlargement; and associated with this condition are evident pallor and weakness. Later the enlargement of the liver may be noted, and finally hemorrhages from the stomach and bowel, epistaxis, hematuria, and ecchymoses may appear. Jaundice is not particularly common. In the last stages ascites may occur.

Dyspnea and heart murmurs not due to organic valvular defects are common.

**Course and Prognosis.**—In children a tendency to recovery has been noted, and it is not unusual for the disease to progress slowly over a

<sup>1</sup> Amer. Jour. Med. Sci., 1917, 154, 893.

period of years, with only moderate splenic enlargement and diminution in the size of the liver following earlier enlargement.

Death may result from hemorrhage and exhaustion, but is more frequently due to a complication or intercurrent disease.

**Differential Diagnosis.**—*Cirrhosis of the liver* is rare in childhood, usually produces ascites early, runs a rapid course, and seldom is associated with more than slight enlargement of the spleen.

*Hemolytic jaundice* is characterized by excessive fragility of the red corpuscles.

*Syphilis* ordinarily gives a positive Wassermann reaction and produces constitutional or local effects apart from those found in splenic anemia.

*Gaucher's disease* usually begins at an earlier age than splenic anemia, shows familial incidence, causes a peculiar brownish pigmentation of the skin, and produces an extreme degree of splenic enlargement.

Although the splenic enlargement and anemia may be extreme in *malaria*, the diagnosis is ordinarily easy in this affection if the temperature observations and blood examinations are conducted with care.

**Treatment.**—Benefit from splenectomy has been observed in a limited number of cases, the best results being obtained from operation early in the disease. Other measures of temporary value at times employed are x-ray applications to the splenic region and transfusion.

### GAUCHER'S DISEASE

A rare systemic disease involving the spleen, liver, blood, and lymphatic glands, and frequently attacking more than one member of the same family, independently of the direct line of inheritance, was described by Gaucher as "primary epithelioma of the spleen." Only a limited number of cases have been reported. The first manifestations usually occur in early childhood.

**Pathology.**—The splenic enlargement is slowly progressive and extreme. The liver is involved to a lesser degree. Microscopically both organs show deposits of large distinctive multinuclear endothelial cells, and these cells are found also to some extent in the bone-marrow and lymph-glands.

**Symptoms.**—Associated with the slowly progressing increase in size of the spleen there is a secondary anemia and leukopenia, a variable degree of adenopathy, and a brownish-yellow discoloration of the skin of the face without actual icterus. Yellowish wedge-shaped thickening of the conjunctiva at the corneal margin is at times observed.

Hemorrhages from the mucous membrane and under the skin may occur, but hematemesis is not observed. Ascites, as noted in Banti's disease, is likewise absent.

**Course and Prognosis.**—The duration of Gaucher's disease is measured by years. Death is usually due to an intercurrent illness.

**Diagnosis.**—The age of the patient, the family history, and the symptoms outlined are sufficient for a diagnosis. In confirming the existence of the disease in a given case examination of a section of splenic pulp for the typical lesions may be a necessary procedure.

**Treatment.**—The disease is probably too generalized to be influenced

by splenectomy, although improvement has been reported in a few cases following this operation.

### HEMOLYTIC ICTERUS

This form of jaundice, like Gaucher's disease, exhibits a familial tendency, but, unlike Gaucher's disease, is usually hereditary through both male and female antecedents.

The jaundice is usually manifest soon after birth and may be only moderate, the stools remaining dark, but the urine showing an excess of urobilin without bile-pigment. The spleen is enlarged, at times to a marked degree. Anemia is the rule. A distinctive feature is abnormal fragility of the red corpuscles as measured by the action of hypotonic salt solution.

The duration of this affection may be that of normal life, affected subjects often showing little general ill effects from the condition.

An acquired type of hemolytic icterus without the familial characteristic is recognized.

### THE LYMPHATIC GLANDS

Lymphatic gland enlargement is of most frequent occurrence in children. It is quite usual, in making a physical examination in children, to find the postcervical and the inguinal glands slightly enlarged. Such enlargement is frequently of no significance.

Infants and young children possess a ready susceptibility to gland infection. General glandular involvement in a child who is in a depleted condition may be of no consequence. In such cases the glands will show but very slight or moderate enlargement. In pseudoleukemia, leukemia, and lymphatism the glands will show a vastly greater degree of hyperplasia, and the blood examination will determine this condition. In syphilis the only glandular involvement of diagnostic significance will be found in the epitrochlears.

In tuberculosis the process is often localized, usually at the angle of the jaw. The inguinal glands are often found enlarged in eczema, intertrigo, and in balanitis.

### ACUTE CERVICAL ADENITIS

**Etiology.**—In cervical adenitis the inflammation results from the draining of an infected source, which may be a decayed tooth, a diseased tonsil, purulent rhinitis, otitis media, or any focus from which bacteria may be transferred. In grip, tonsillitis, scarlet fever, diphtheria, measles, and in any throat infection adenitis may be, and frequently is, a complication. Pediculi of the scalp are very apt to produce involvement of the posterior cervical glands.

**Pathology.**—The process in the gland may be a simple hyperplastic change, or it may reach the stage of suppuration. The micro-organisms most commonly associated with suppurative adenitis are the streptococcus and the staphylococcus, but the pneumococcus, the gonococcus, and the typhoid bacillus have been cultivated from diseased lymph-glands in various regions.

**Symptoms.**—The first symptom noticed will be that of a swelling, typically at the angle of the jaw (Fig. 80), hard, rounded, and quite painful to the touch. Preceding the enlargement there may be a period of fever for a day or two, during which time the child moves the head awkwardly. Rarely one gland alone will be involved. Usually there are several, although the external examinations will make it appear that one, or at the most, two, are enlarged. The tumor may reach a very large size, so that the entire space between the jaw and the clavicle is filled in and almost replaced by these glands.



Fig. 80.—Cervical adenitis.

The temperature is usually high, in simple adenitis with suppuration frequently ranging from  $102^{\circ}$  to  $105^{\circ}$  F.

**Duration.** The course varies widely. If there is a streptococcus infection, suppuration may occur in a few days. In scarlet fever this micro-organism is usually the infecting agent, a fact which accounts for the many suppurating glands that occur with this disease.

**Termination.**—The infection always terminates in one of three ways: First, resolution; second, suppuration; third, persistent enlargement (chronic adenitis).

**Differential Diagnosis.**—Acute adenitis and mumps are very frequently confused. By a comparison of Figs. 80 and 117 it will be readily seen that the two conditions have but little in common. In mumps the parotid gland is involved and the swelling is situated close to the ear, with the space posterior to the lobe filled in by that portion of the parotid gland.

**Prophylaxis.**—A normal, resistant oral cavity is the best safeguard against cervical adenitis. Removal of bad teeth and adenoids and enucleation of diseased tonsils are better insurance against cervical gland infection than all other measures combined.

**Treatment.**—After treating many hundreds of cases of adenitis, we have been impressed with the great value of cold applications in the form of a cold-water compress changed every fifteen minutes to half-hour, day and night. Such treatment is arduous, and, of course, in many instances impossible, particularly in dealing with young infants. With older children the dressing may be changed without awakening the patient. For infants the treatment may be continued with good effect from fourteen to sixteen times a day. The last dressing for the night is to be kept bound on the parts. The use of ointments and local applications other than cold is disappointing. The ice-bag is not so satisfactory as the wet compress.

**Suppurative Cases.**—Even when the cold compress or ice-bag is applied at the first suggestion of swelling and used faithfully, the cases of streptococcus infection usually go on to suppuration. When the swelling softens we know that suppuration has taken place, and our only treatment is to incise freely, allowing the pus to escape, and place in the wound a strip of sterilized gauze to assist in drainage and to prevent too early closure of the incision. The wound should be dressed once daily. Extirpation of the diseased gland is not to be advised until later, if at all. In fact, a greater part of all the gland tissue may have undergone suppuration, producing complete destruction.

Repeatedly we have seen the adenitis, which is often an early complication of diphtheria, disappear quickly after full doses of diphtheria antitoxin.

#### PERSISTENT CERVICAL ADENITIS

After an acute adenitis, in a small percentage of cases, the gland or glands will remain persistently enlarged, so as to constitute a deformity. The deformity may likewise be the result of a series of acute attacks, each leaving the gland a little larger than before. Whether these glands are tuberculous from the outset, or become so later, it is impossible to state. We know, however, from observation of many patients that some cases which do not show the distinctive characteristics of tuberculous adenitis which we have been taught to expect, do show that they are tuberculous upon examination of the glands which have been removed at operation because of the unsightly deformity. We have, therefore, come to look upon pronounced persistent adenitis as probably of tuberculous origin, even though but two or three glands appear to be involved. Because these chronically enlarged glands sometimes undergo resolution without suppuration does not prove the absence of tubercle bacilli.

## AXILLARY AND INGUINAL ADENITIS

In axillary and inguinal adenitis the infected area from which the process has its origin must be eradicated. In the inguinal cases balanitis in boys and vulvovaginitis in girls are frequent sources of infection. Axillary



Fig. 81.—Axillary adenitis.

adenitis (Fig. 81) is very unusual. When it occurs, the infection has usually been carried from a lesion somewhere in the upper extremity.

## GLANDULAR FEVER

Glandular fever is a disease of early childhood. It is characterized by swelling of the lymph-nodes at the angle of the jaw forming an elongated tumor between the angle of the jaw and the sternomastoid muscle. The tumor may reach a considerable size. We have seen cases in which the tumors were as large as hen's eggs. Both sides are usually involved; the swelling is first noticed on one side and is usually followed by an infection of the glands on the opposite side. Rarely are the axillary and inguinal glands affected. Fever is present, usually from 101° to 104° F., and there is prostration and loss of appetite.

The disease occurs most frequently in epidemic form, although sporadic cases are not unusual. Park West described an epidemic of 96 cases in 43 families during a period of three years. A large epidemic was described by Schaffer in 1909. A similar outbreak reported by Haas<sup>1</sup> occurred in New York City in the spring of 1911. During this epidemic the senior author treated 30 cases in his own private practice.

**Pathology and Bacteriology.**—The pathology of this affection is obscure. Thus far the evidence at hand tends to point to a streptococcus

<sup>1</sup> Amer. Jour. Dis. Child., April, 1912, 241.

infection, and with the improved technic of blood-cultures in infants an answer to this question should be forthcoming in the near future. Cultures from the throat have shown no uniform results, but in many instances streptococci have been found in glands either at autopsy or operation. Korsakoff found streptococci in pure culture in the cervical and axillary glands, liver, spleen, kidneys, and heart's blood, while in the same case the glands showed an acute hyperplastic change with dilated blood-vessels. In reports of cases blood-cultures during life are usually not mentioned.

**Differential Diagnosis.**—This disease is to be differentiated from mumps in that the parotid glands are not involved, and from acute simple adenitis by the absence of throat involvement, and by the fact that nearly all cases terminate in recovery without suppuration or resulting persistent adenitis. In several of the cases seen during a recent epidemic the rhinopharynx was normal. Two or more children in a family may have the disease at the same time.

In the case of a boy fourteen years old with extreme bilateral cervical adenitis accompanied by temperature of 104° F., but no throat manifestations, a cobweb-like film noted along the gum margins at the site of the molars yielded an unusually good smear of *Vincent's spirillum and bacillus*. Previously the case had been regarded as one of typical glandular fever.

**Treatment.**—The treatment consists in enforced rest in bed, a reduced diet of broth and gruel, the continuous use of the ice-bag or the cold compress (p. 317), and the employment of laxatives, such as milk of magnesia, sufficient to produce one or two evacuations daily. The swelling may last from five days to two weeks, and in all our cases has subsided without suppuration.

#### TUBERCULOUS ADENITIS

Tuberculous adenitis is a term applied by common consent to tuberculosis of the cervical lymph-nodes. In cases of early and localized tuberculous involvement these glands, more often than any other structures, harbor the bacilli. Furthermore, because of the possibility of ready access to the source of the disease, these cases afford a better prognosis as regards its eradication than do cases of tuberculosis in any other part of the body.

**Age.**—The age incidence is interesting. Cases are rarely seen before the third year and do not often develop after the eighth year. Exceptionally cases develop much later. One patient was a girl sixteen years of age who was otherwise healthy.

**Conditions Favoring the Development of Lymph-node Tuberculosis.**—Diseased tonsils and adenoids are the most fruitful cause of tuberculous cervical lymph-glands.

Whether previous inflammatory condition of the glands makes them a more favorable focus is not known; neither do we know when the glands become tuberculous. Is the tubercle bacillus the first offender? Holt believed that in most cases tuberculosis is the primary infection. Heredity probably plays no part in causation. That lymphatism may predispose an individual to the infection is extremely doubtful. It has not been our observation that children predisposed to glandular enlargement

from some systemic cause are especially susceptible to bacterial infection. It is apparent that tuberculous glands are dependent for the infection upon the presence of tubercle bacilli in the food and air, and upon a means of communication to the gland which is supplied by those lymphatics the function of which is to drain bacteria-laden tonsils and adenoids and diseased teeth.

Contributory to this belief is the fact that the age from the third to the eighth year is the period during which diseased tonsils and adenoids are of the most frequent occurrence.

**Types of Infection.**—In the majority of cases of primary cervical adenitis in children the tubercle bacilli, which have been isolated by observers in this country, England, and Germany, have conformed to the human type. From bronchial and mesenteric lymph-nodes affected with tuberculosis in young children Goffissey isolated the human type in 55 out of 57 cases. In 2 the bovine strains were present in the bronchial nodes.

Stiles of Edinburgh has made a searching study of the surgical tuberculosis of childhood, with particular attention to the mode of origin and character of the infection. He found that the greater part of lymph-gland tuberculosis to which Scotch children were subject was derived from milk obtained from tuberculous cows, the bovine organism greatly predominating in the infections with which he had to cope. He has emphasized the importance of the tonsil as a frequent portal of entrance for the bovine organism thus ingested in milk.

Tuberculous glands which have undergone suppuration are frequently the seat of a secondary infection with the streptococcus.

**Symptoms.**—A symptomatology of value in tuberculous adenitis is most difficult, as we do not know positively when a gland becomes infected and knowledge of very early symptoms is therefore out of the question. Cervical glands are prone to enlargement. One or more may enlarge and disappear or diminish in size, and enlarge again and disappear, and never trouble the child thereafter. In another case perhaps the same involvement occurs, but the glands do not diminish in size or disappear as formerly, but, on the contrary, remain enlarged. In well-developed adenitis the glands cease to be movable. A periadenitis binds them to the skin and the adjacent tissue and probably to the adjacent glands. Usually one side of the neck is involved. The involved glands may be small or large. Repeatedly tuberculous glands as small as a pea may be seen undergoing typical cheesy degeneration. Secondary infection is productive of abscess; the skin over the superficially seated gland becomes acutely reddened and breaks down if not opened, permitting the discharge of thin, light yellow pus. Other glands undergo the same process of infection, followed by cheesy degeneration and suppuration, with the formation of a sinus and destruction of skin. Attempts at resolution produce cicatricial changes which add to the unsightliness of the wound. The entire process is chronic.

**Diagnosis.**—The most common form of long-standing cervical adenitis is the tuberculous type. Failure of swollen gland masses in this location to diminish in size after the removal of diseased teeth and tonsils and the cure of otitis media and scalp infection, such as that secondary to

pediculosis, is presumptive evidence that the glands involved are actually tuberculous. The positive intradermal tuberculin test, while not diagnostic of the particular local condition, is significant.

The value of the Roentgen ray in revealing calcified tuberculous cervical nodes has been emphasized in a special report by Hanford.<sup>1</sup> When further evidence is necessary pending extensive operative procedure, the removal of a small gland or section of tissue from the affected region will render possible accurate microscopic diagnosis.

**Prognosis.**—The prognosis is the same as in so many diseases in which the treatment is surgical. The outlook is most satisfactory if the surgeon is given an opportunity to operate early.

The girl of sixteen years previously referred to was undergoing treatment for tuberculous nodes by means other than operation. After three months of treatment she developed tuberculous meningitis.

**Treatment.**—If the gland may be diagnosed as tuberculous, radical procedures should be brought into the case. If the diagnosis is not positive, but the swelling persists to a degree sufficient to produce a deformity, the case should be placed in the suspected class and treated as if tuberculous.

*Surgical Treatment.*—The operation is usually attended with most satisfactory results, but should be attempted only by a competent surgeon. We have known results that were not satisfactory. The possibilities of an unsightly scar deter many parents from assenting to an operation. If the operation is performed by the Dowd method before ulceration of the skin develops, the scar is negligible and long before adult life is reached will be inconspicuous.

After the operation the child should, if possible, be given the advantage of an outdoor life in the country, inland. These cases appear to improve most rapidly at an elevation of 800 feet or more. The diet should consist of meat, eggs, milk, and of high-protein cereals, such as oatmeal and the dried legumes, given in the form of purées. It is a good custom to order cod-liver oil and malt to be given in doses of from 1 teaspoonful to 1 tablespoonful after meals for one week, followed for one week by the syrup of the hypophosphites. The oil and maltine may then be resumed for the same time, thus alternating indefinitely with the hypophosphites. If an examination of the blood shows that the patient is anemic, iron may be used in connection with the other remedies. The citrate of iron and extractum ferri pomatum are well borne by the stomach, and have appeared to be of considerable service in some cases. To children from five to ten years of age 1 grain of the citrate of iron and quinin in sherry wine, or 1 grain of citrate of iron and ammonia in water, may be given after meals. The dose of extractum ferri pomatum at this age is  $\frac{1}{2}$  grain after each meal.

*Heliotherapy.*—The value of the x-ray and various forms of light therapy in the treatment of certain cases of tuberculous adenitis has been demonstrated. This method is often of particular value when combined with operative treatment. The details of such procedure rest

<sup>1</sup> Roentgen-ray Diagnosis of Tuberculous Cervical Glands, Amer. Jour. Med. Sci., No. 4, vol. cxiv, p. 539.

with those skilled in this work, who should advise at all times concerning the applicability of the method in a given case. In our experience the method has been disappointing.

### HODGKIN'S DISEASE

**Definition.**—Hodgkin's disease is a granulomatous disease of lymphoid organs marked by enlargement of chains of lymph-nodes which show a characteristic pathology, by progressive anemia, and a fatal termination.

**Etiology.**—The specific cause is unknown.<sup>1</sup> Hodgkin's disease is rare in children and very exceptionally occurs under three years. Its relation to tuberculous infection has not been proved, although there is a large amount of data in favor of such a hypothesis.<sup>2</sup> Attention has been called by Bunting, Yates, and Torrey to the presence of diphtheroid organisms, aerobic and anaerobic, in the diseased nodes.

**Pathology.**—The disease is characterized by multiple enlargement of lymph-nodes in many regions. The nodes are usually discrete, non-infiltrating, and in over 50 per cent. of the cases first affected in the cervical region.<sup>3</sup> The axillary and inguinal nodes may become involved, as may the mediastinal and retroperitoneal groups. In 60 to 70 per cent. of the cases there is splenomegaly and enlargement of the liver. On section, all these tissues present the same cellular picture. There is marked hyperplasia of the reticulum with proliferation of the endothelium, endothelial giant-cells, plasma cells, eosinophil cells, and lymphocytes, small and large.<sup>4</sup> Areas of necrosis are uncommon except in very acute cases or long-standing cases of great bulk. The node capsules remain intact and there is no infiltration except that blood-vessels may be occluded by invasion of the walls.

**Clinical Course.**—The onset may be gradual, with rather indefinite skin manifestations of an eczematous nature. However, progressive enlargement of cervical lymph-nodes is usually the first clinical evidence of Hodgkin's disease. The swellings are hard, painless, show no signs of acute inflammation or suppuration, and remain discrete, manifesting little tendency for the glands to coalesce. With the progress of the disease more general symptoms are observed. Enlargement of the cervical and mediastinal glands may give symptoms associated with pressure on contiguous structures, such as cough, dyspnea, pain, and even pressure ulceration. Symmers has reported a case of ulceration of the trachea from pressure of mediastinal nodes.

In a recent case of a child two years of age the cervical, axillary, and inguinal glands were all greatly enlarged. There was no appreciable increase in size of the spleen.

Gastro-intestinal disturbances occur, with further involvement of abdominal nodes.

The spleen is usually but not invariably enlarged. Fever may or may not be a prominent feature of the picture. With generalization

<sup>1</sup> Zeigler: General Pathology, 5th Amer. ed., 1921.

<sup>2</sup> Ewing, Neoplastic Diseases, 2d ed., 1922.

<sup>3</sup> Ibid.

<sup>4</sup> Reed, On the Pathological Changes in Hodgkin's Disease with Special Reference to its Relation to Tuberculosis, Johns Hopkins Hospital Reports, vol. x, Nos. 3, 4, and 5.

of the disease, the temperature may present wide fluctuations. There is an accompanying cachexia at this stage.

The blood shows a marked secondary anemia with little or no decrease in the red cells, but a marked fall in the hemoglobin. There is little if any leukocytosis, except in the presence of secondary infection. The white blood-counts average about 10,000, but may be high during both the early and late stages of the disease. There may be slight polymyeloeliosis. Eosinophilia is common.

The duration of the disease varies in children from a few months to about three years. Rarely do cases run longer. In our cases the duration has been from one to two years.

**Diagnosis.**—*Tuberculosis.*—In Hodgkin's disease the nodes are more slowly progressive, are harder, show no signs of acute inflammation or suppuration, and remain discrete, whereas tuberculous nodes tend to coalesce. The coincident wide distribution of Hodgkin's nodes is not typical of tuberculous involvement. The tuberculin test may be of help in afebrile Hodgkin's disease.

*Lymphatic leukemia* may be differentiated by repeated examinations of the blood and the more rapid clinical progress with nodes which do not usually reach the size of Hodgkin's nodes.

*Lymphosarcoma* usually presents coalesced nodes, causes no fever, seldom produces splenomegaly, and is more rapid in its course, soon invading surrounding tissue.

From the *pseudoleukemia of Cohnheim* Hodgkin's is clinically indistinguishable. Only by microscopic section of an excised gland can differentiation be made.

The best single diagnostic clinical sign in Hodgkin's disease is the characteristic glandular involvement. Mediastinal x-ray is important.

**Prognosis.**—The termination is always fatal.

**Treatment.**—When Hodgkin's disease is suspected clinically, a biopsy should be performed and the diagnosis be decided by the pathologist. Arsenic in full doses is advised, but at present radiation over the affected areas with x-rays and radium-packs offers the best palliative treatment. Apparently there is some prolongation of life by these means, but the ultimate outcome is the same.

## THE BREAST

### MASTITIS IN YOUNG GIRLS

Inflammation of the mammary gland in young girls is a comparatively rare condition, but one of sufficiently frequent occurrence to require mention. Swelling and tenderness of the breasts, although often complained of by young girls about the time of puberty, subside without treatment if let alone. In such cases there is no rise in temperature and the tenderness and enlargement may remain for several weeks. One breast only may be involved, and the swelling may anticipate the first menstruation by several months.

The patients with true mastitis have varied in age from seven to twelve years. The condition is usually due to the entrance of bacteria through the nipple, and in its clinical manifestations the condition resembles mas-

titis in the adult, except that the entire gland is usually involved, becoming swollen, tender, and excruciatingly painful. There is slight fever—not above 101° F.—headache, and lassitude.

**Treatment.**—Satisfactory treatment during the acute stage has consisted in the use of an ice-bag, which is kept intermittently applied during the waking hours. At night a wet dressing of bichlorid of mercury, 1 : 5000, may be kept on the infected glands. A saline laxative in the form of citrate of magnesia should be given at the onset, and a diet of broth, gruel, toast, and stewed fruit is to be continued during the period of fever. Recovery is usual under two weeks. The ice-bag has not been required for more than three or four days. After this period the wet dressing answers the same purpose.

## THE THYROID GLAND

### SIMPLE ENLARGEMENT OF THE THYROID

*Physiologic congestion*<sup>1</sup> of the thyroid is one of the most common conditions affecting the gland in young female subjects, a “premenstrual congestion” of the thyroid being common just prior to the first menstruation. The enlargement of the gland may subside as the menstruation becomes established, but not infrequently recurs with each menstrual period.

Aside from the swelling referred to the symptoms and signs are insignificant and no treatment is indicated.

### CONGENITAL GOITER

This type of goiter, chiefly in the vascular and parenchymatous forms, occurs occasionally in infants, exhibiting the influence of heredity, particularly on the maternal side.<sup>2</sup> By the imposed resistance to head flexion which it may occasion this form of goiter tends to cause face presentation at birth. The thyroid is subject to additional congestion from occasional constriction of the neck by the umbilical cord.

In mild cases in infancy no inconvenience may be entailed, but as a result of a so-called fulminating type of the disease the child may be dead at birth, or if living, show cyanosis, dyspnea, stridor, and exophthalmos preliminary to an early death.

**Treatment** consists in the inunction of potassium iodid ointment (Crotti):

Kal. iodat. ....	10 grams
Aq. dest. ....	10 “
Lanolin. ....	30 “
Vaselin. ....	70 “

For the urgent cases cold compresses locally may be of service.

When the dyspnea persists, isthmectomy or partial thyroidectomy is to be considered, tracheotomy being more frequently productive of pneumonia.

Proper treatment of goitrous mothers during pregnancy with thyroid

<sup>1</sup> Crotti, Thyroid and Thymus, Lea & Febiger, 1922, pp. 129–131.

<sup>2</sup> Ibid., pp. 182–185.

extract or iodine is said to prevent the development of congenital goiter in the offspring.

### SIMPLE GOITER IN OLDER CHILDREN

With children the various forms of goiter found in adults are at times presented, the frequency of the disease being greater in girls at puberty. The simpler types of goiter are amenable to potassium iodide in doses of 5 to 10 grains daily.

### EXOPHTHALMIC GOITER

Occasional cases of true hyperthyroidism with the symptoms of typical exophthalmic goiter are observed in children who may or may not have shown abnormality of the thyroid. The incidence of this disease is greater in late childhood and the management is the same as that indicated for disease in the adult.

The physician will do well to remember the comparative rarity of the condition in comparison with the exceeding frequency of simple swelling of the thyroid so frequently observed at puberty.

Kimball and Marine<sup>1</sup> showed by extensive experiment at Akron, Ohio, that 0.2 gm. of sodium iodide given daily for ten consecutive days, twice yearly, would effectually prevent goiter in children.

Hunziker and Wyss<sup>2</sup> made observations upon several hundred school children in Switzerland at an interval of several months during which about half of the children received regularly 0.04 gram of potassium iodide, while a similar group were untreated. In the untreated boys and girls the gland increased 2.1 to 2.8 cm., while in those under treatment it decreased 7.2 to 7.6 cm. These observations indicate strongly the value of iodine even in small doses as a prophylactic against goiter.<sup>3</sup>

### CRETINISM (INFANTILE MYXEDEMA; CRETINOID IDIOCY)

Cretinism was described by Paracelsus early in the seventeenth century. Until the middle of the nineteenth century, however, the disease was only imperfectly differentiated. Fagge described the sporadic form in 1871, and in 1873 Gull emphasized the similarity of this disease to adult myxedema. Some years later, following the experiments conducted by Victor Horsley, a commission appointed by the Clinical Society of London reported that myxedema and cachexia strumipriva were identical, that sporadic cretinism was myxedema occurring in childhood, and that endemic cretinism was closely allied to myxedema. The successful work of Schiff, von Eiselsberg, and Horsley in the artificial grafting of thyroid gland induced George R. Murray in 1891 to employ hypodermic injections of an extract of the gland in the treatment of myxedema. Howitz, Fox, and MacKenzie obtained equally good results from thyroid medication by mouth. The wonderful success of this form of organotherapy during the five years following its initial use led Osler to write: "Not the magic wand of Prospero, or the brave kiss of the daughter of Hippocrates, ever effected such a change."

<sup>1</sup> Arch. Int. Med., 1918.

<sup>2</sup> Schweiz. med. Wchnschr., January 19, 1922.

<sup>3</sup> Practical Medicine Series, Pediatrics, 1922, vol. iv, pp. 137, 138.

Cretins usually do not come under observation before the sixth month. Not much is expected of a baby a few months old, and if he is very quiet and slow at noticing his surroundings, the fact is attributed to his tender age or to his being a good baby. When, however, at the fifth, sixth, or seventh month, he fails to show the usual response for his age, medical attention is called to the condition. When first seen the patients have usually been from six to eighteen months old. A cretin girl three years old weighed 15 pounds, 3 ounces.

**Etiology.**—It is undoubtedly established that the condition termed "cretinism" depends upon the absence of the thyroid secretion, and that the various degrees of cretinoid idiocy hinge upon the partial or complete absence of the thyroid gland. Cretinism varies in degree and in the time of its development. In typical cases (Fig. 83) there is complete absence of the thyroid gland; in others, showing the disease in less severe form, an impaired thyroid is found.

**Pathology.**—In 14 of 16 autopsies collected by Fletcher Beach the thyroid was absent. In 100 cases of Curling, Fagge, and Iphophon the gland was wholly absent in 25; in the other 75 various connective-tissue and colloidal changes were observed. In endemic cretinism ("not found in this country," Osler) alterations are found in the thyroid consisting of partial or complete degeneration, which may be either atrophic or goitrous in its inception; or, as Getzowa has described, cases are found in which atrophic areas and goitrous degenerated nodules alternate in the same gland. In sporadic cretinism there is usually congenital absence of the gland, while in infantile myxedema due to acquired loss or perversion of thyroid function in the early years of life the symptoms vary according to the amount of functional disturbance. According to Kochei, in myxedema there is always abolition of the function of the gland, which at autopsy is never normal. In the majority of cases it is replaced by a band of tissue (Virchow); at other times, by adipose tissue without a trace of the thyroid artery (Stilling).

Ord was the first man to examine microscopically the thyroid in a case of myxedema. In the majority of instances neither Virchow nor Horsley, in their extensive observations, was able to find vestiges of acini or thyroid cells—masses of connective tissue occupying the region of the gland. Stilling made similar investigations, and found the thyroid artery missing, while Langhans characterized the changes as those of an interstitial inflammation, with embryonal cell infiltration; in fact, an inflammation comparable to cirrhosis of the liver. By degrees the tissues become



Fig. 82.—Cretin four years old never having received thyroid treatment.

sclerosed and the vessels undergo endarteritis obliterans, while the acini become atrophied and disappear. As these changes progress the function of the gland diminishes.

The parathyroids are normal. The hypophysis cerebri is atrophied in some cases and hypertrophied in others. The brain shows no gross abnormality. The genitals are infantile in character. The skin is thick, with a scanty development of hair and sweat-glands. The adipose tissue is very abundant, both beneath the skin and in the omentum; often there are pads of fat above the clavicles. The entire osseous system shows a lack of development and ossification.

**Symptoms.**—When very young—under one year of age—the children are dull and mentally backward; they are passive, and show little or no interest in their surroundings; they resist manipulations, such as dressing, bathing, and physical examination, but little if at all. The extremities usually are cool, oftentimes slightly moist.

The general appearance is characteristic (see Fig. 84) regardless of the child's age. The hair is dry and coarse; the face is broad; the nose wide and flat, and the lips are broad and thick. The tongue protrudes between the lips. The tissues have a doughy, edematous appearance and feel boggy to the touch, but do not pit. The forehead is low. The abdomen is usually large, and there is almost invariably an umbilical hernia. The neck is short and thick. The hands and feet are large; the fingers and toes are short and thick. The patients are very short in stature.

A typical cretin girl was but 26 inches tall when three years of age.

The fontanel is widely open. Dentition is greatly delayed. The temperature is usually subnormal.

The cretin walks late, rarely, if untreated, before the third year.

Figure 82 represents a cretin four years old who could not stand without assistance. He was when photographed 31½ inches tall.

Mentally and physically such individuals are slow and inactive. The mental impairment is considerable, idiocy being the outcome in most of the untreated cases.

*Acquired Cretinism.*—In some early development is fairly normal, and the unmistakable signs do not appear until the child is several months of age.

*Illustrative Case.*—A girl, three and one-half years of age, with delayed or acquired cretinism, was perfectly normal until the third year of age. She then became inactive and took no interest in her surroundings. The hair became coarse and dry, the extremities cool. The expression was dull and listless. The child presented a general edematous appearance. The diagnosis of cretinism was proved by a prompt response to thyroid medication.

**Diagnosis.**—The diagnosis in typical cases is made without difficulty. The nature of the trouble is stamped on every feature. The slow mental responses and the dwarfed, edematous extremities furnish a picture that is simulated by but one other condition, and this is Mongolian idiocy. In the Mongolian the round face, the elliptic eye, and the absence of shortening in the long bones are sufficient to establish a differentiation.

**Prognosis.**—The prognosis for a complete recovery is good if the case is discovered before the eighth month. Several patients under treatment have become apparently normal children as judged by school and family standards. No one knows that these children are cretins. In cases in which treatment is not begun until after the first year—surely after the eighteenth month—the chances of normal mentality are lessened. The earlier the case comes under treatment, the better the possibilities for the patient, both physically and mentally.

**Treatment.**—*The Thyroid Treatment.*—The specific treatment is the thyroid treatment. The most pronouncedly beneficial results of this treatment are noticed when it is brought into use early in life. The diagnosis of cretinism is, however, rarely made before the fifth or sixth month, often much later, for the reason that the case does not happen to come under the observation of those competent to make the diagnosis.

*Illustrative Cases.*—In 2 cases the patients were first seen by the writer at the fifth and the seventh month respectively. Other cases have been treated in institution and in private work. The two referred to, however, were seen earlier and almost

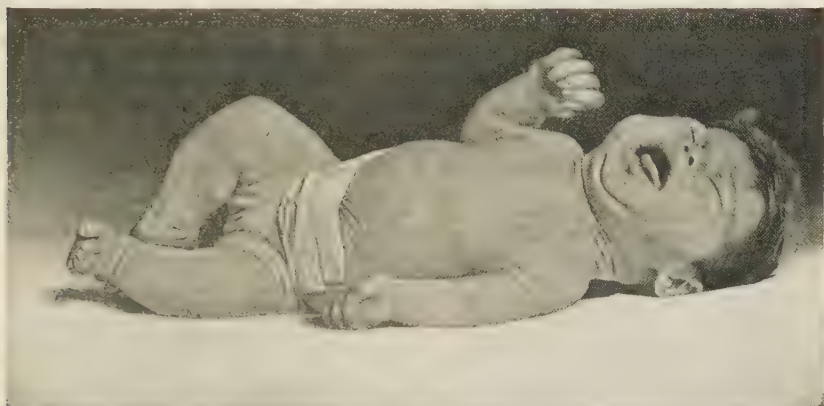


Fig. 83.—Cretin, aged six months, before beginning thyroid treatment.

daily for months, consequently there was an excellent opportunity for observing the effects of the thyroid administration. The desiccated thyroid extract of Parke, Davis & Co. was used.

A fairly complete history of the progress of one of the cases is as follows: The beneficial effects were noticed in three days. The first change for the better was observed by the mother, who stated that the child seemed warmer and that less bed-clothing was necessary. The next positive change occurred, according to the records, on the fifth day of treatment. The child's general condition was very much improved. Her extremities were warmer, her color better, and she commenced to use her arms; but what particularly impressed the mother was that less bed-clothing was needed to keep the child warm. At about the seventh day of treatment the patient cried vigorously when disturbed for the purpose of changing the napkin—something which she had never done before. She had previously been stupid and apathetic. The next changes for the better rapidly followed; the patient noticed and appeared interested in her mother, and followed the latter about the room with her eyes, and while previously the child had rarely used her legs and arms except when disturbed, she now began to move them about voluntarily; as the mother expressed it, "the child had acted as though she were under the influence of some powerful depressing drug whose effects were gradually wearing off." When the child was five and one-half months old, after she had been under treatment for sixteen days, receiving  $\frac{1}{2}$  grain of thyroid twice daily, she smiled for the first time. She cut the first tooth at the ninth month, and walked alone at the fourteenth month. She ultimately took 5 grains daily, and seemed appar-

ently normal in every respect. She attends school, and is but one grade below the average school child of her age, which means that she is in the same grade with other children who are normal.

When the child in whom treatment was commenced at the seventh month was nine months of age it was found necessary to give  $\frac{1}{2}$  grain three times daily. One month later  $\frac{1}{2}$  grain was given four times daily. At this time the child could sit up and hold the head erect. The increase in the thyroid extract produced vomiting, and the dosage of  $\frac{1}{2}$  grain three times daily was resumed. One year after the commencement of the treatment, when the patient was nineteen months old, 2 grains daily were required.

In both of these infants the protrusion of the tongue was one of the latest symptoms to disappear.

*Dosage.*—The increase in the thyroid administration must be determined by the condition of the patient. As long as progress is shown in more active and normal mentality, with an increase in the growth of the long bones and a gradual loss of the typical facial and bodily characteristics, it is unwise to increase the dosage of the thyroid. When, however, a period arrives when no progress appears to be made, the daily dosage should gradually be increased by  $\frac{1}{2}$  grain. Evidences of over-dosage are pallor, prostration, perspiration, and indigestion. When any of the above signs present themselves, the medication should be discontinued for twenty-four hours and then resumed with smaller doses.

Our cases have varied considerably as to the amount of thyroid required. The dosage used was that taken by those in whom the disease was discovered very early in life. The older the patient when the thyroid medication is begun, the less marked are the beneficial results.

*Case 3.*—A girl patient, nine years old, and normal in every respect except that her hair remained rather coarse, with a tendency to dryness of the scalp, was found to require the following amounts of desiccated thyroid at the various ages:

Six months.....	1 $\frac{1}{2}$ grains daily
One year.....	3 $\frac{1}{2}$ " "
Two years.....	5 " "
Three years.....	9 " "
Four years.....	8 " "

This patient both walked and talked at fifteen months. In her case, in order to determine what the effects of the withdrawal of the treatment might be, the thyroid was discontinued. This was first attempted when she was two and one-half years of age. The mother was asked to keep close watch in order to detect the slightest difference in the child's behavior. After three days without thyroid it was noticed that the child became less active and disinclined to play. She was not irritable or cross, but would sit in her little chair the entire day. She had previously been very bright, active, and talkative. A few days later she ceased to talk voluntarily and answered only when spoken to. After an interval of twelve days the thyroid was resumed, and her activity again returned. About one year later a similar trial was attempted, with similar results, although the duration of the test was shorter, as the mother, who was a dispensary patient and had had the thyroid furnished her, purchased a bottle of tablets and gave them on her own responsibility. The child, when nine years old, was taking 12 grains daily. She was a normal, healthy school girl, alive to all interests of girlhood, and no one outside the family circle in the village where she resided knew that she was a cretin.

*Case 4.*—The patient shown in Fig. 84, A was eight and a half years of age, with weight 40  $\frac{1}{2}$  pounds and height 37  $\frac{1}{4}$  inches, the figures representing about the normal for a girl three and a half to four years of age. The first tooth was cut at the fifteenth month. The child walked first at the third year. She was dull, inactive, and took no interest in her surroundings. The heart, lungs, kidneys, and blood were negative. The abdomen was very large and protuberant and there was a large umbilical hernia. The hair was dry and coarse, the skin dry and harsh and cool to the touch, the nose flat, and the lips thick. The teeth were poorly formed and decayed, six in the lower, and five in the upper jaw. None of the second set had appeared. The

child's vocabulary consisted of a very few words. She did not care for play and had no interest whatever in other children. In fact, as the illustration shows, she had all the signs of cretinism.

She was given a suitable diet and the desiccated thyroid. After a little experimenting it was found that 2 grains of thyroid a day met the requirements.

Figure 84, *B*, from a photograph taken one year and two weeks later, shows an entirely different child. Her weight was then 49½ pounds and her height 43½ inches. She had gained 6½ inches in height and 9 pounds in weight. The character of the hair was most noticeable, for it came in soft and silky. Particularly remarkable was the fact that the large umbilical hernia was replaced by a fairly normal umbilicus without the employment of any local corrective measures.



Fig. 84.—Effect of one year's thyroid administration upon an eight-year-old cretin girl. (Case 4.)

The opinion has been expressed by many observers that not a great deal is to be expected from thyroid administration when its use is begun after the period of infancy. This child's mental improvement, however, was surprisingly great and kept pace with the change for the better in the physical appearance. It is difficult to realize that the figures represent photographs of the same child taken only one year apart.

The thyroid must be continued during the lifetime of the patient; when it is discontinued the mental processes soon begin to lag. Indifference to surroundings and aversion to physical effort soon appear, all to disappear again when the thyroid is resumed.

## THE THYMUS GLAND

The thymus consists of two lobes, faintly red in color. They are more or less pointed toward the upper part, rounded off toward the lower, and bound together with loose connective tissue. The organ is situated in the anterior mediastinum, and the greater portion of the gland lies behind the manubrium and body of the sternum. Sappey demonstrated that the thymus in the newborn infant reaches from the upper edge of the manubrium 5 cm. downward, while the upper border at times may reach the isthmus of the thyroid, or be 2 to 3 cm. below it. The sides and lower portion are covered by the folds of the mediastinum, while the anterior borders of the lungs and loose connective tissue separate the gland from the chest wall. Posteriorly in its upper two-thirds the gland covers the pericardium and the beginning of the great vessels, the elongated upper edges covering the trachea. The vagi and phrenic nerves and common carotid arteries bound the thymus on either side, while posteriorly, again in close relation, are the phrenic nerves. The average width of the gland is 2 to 3 cm., and at times the longitudinal diameter may reach  $11\frac{1}{2}$  cm.

**Weight and Size.**—As found postmortem the size and weight of this organ vary considerably, and, at the present time, there is a wide variation of opinion respecting the normal. Exhaustive work on this point was done by Bovaird and Nicoll, who weighed the thymus in 495 consecutive autopsies, the results of which were published in 1906. They found the greatest weight at birth, the average being 7.7 gm. Following this there was little change until the period of five years was reached, from which time a gradual reduction took place. Judging from these observations, one may conclude that the average weight at birth is 6 to 7 gm.; from birth to five years, 3 to 4 gm.; and that any weight over 10 gm. may be considered abnormal.

Olivier, in an extensive monograph, gave the following figures:

Birth.....	4 gm.
1 year.....	6 "
2 years.....	8 "
3 years.....	10 "

He considered all thymi over 15 gm. to be hypertrophied. Sappey, Murkel, and Testut have all quoted figures higher than Olivier. Friedleben and other observers pointed out that these variations in the weight and size of the thymus may be accounted for by the body nutrition. It appears that the thymus shows the results of excessive loss much more than the body as a whole, for in exhausting diseases the weight of the thymus sinks much more rapidly than that of the body. In exceptional cases the reverse is true. Formerly the thymus was supposed to reach its maximum size at birth, and subsequently to atrophy, but more recent observations have shown that remnants persist until puberty, and that true thymus tissue may persist throughout life.

In *status lymphaticus* the thymus often weighs five to ten times more than normal. In well-marked cases its weight may be as high as 55 gm., and in less pronounced cases range between 10 and 20 gm. As a whole, the hypertrophied thymus is a little more vascular than normal, but

aside from hyperplasia shows no other consistent changes macroscopically or microscopically.

Inasmuch as the size and weight of the gland is supposed to determine the existence of status lymphaticus enlargement of the thymus in association with enlargement in other lymphatic structures, has been the subject of a great deal of investigation. We are forced to agree that an enlarged thymus implies the existence of status lymphaticus and this is in accord with the opinion of Friedländer. Liss<sup>1</sup> has reported a thymus gland study covering a series of cases in which the results of the x-ray examinations before postmortem were compared with the findings at autopsy. He has made a classification of shadows comprising three types: the columnar, the bulbous, and the pedicle, all of which are illustrated by roentgenograms. Recognition of the pedicle type was found impossible in the living subject, as the thymus shadow is included entirely in the heart shadow. Liss found the thymus shadow absent in 35 of 119 cases, a small shadow less than 3 cm. in 34 cases, and in 50 a large shadow more than 3 cm. transversely. The observations were made within forty-eight hours after birth. These findings are startling in the sense that about 52 per cent. of the cases showed a transverse measurement of more than 3 cm., a condition that the investigator regarded as pathologic. Later observations showed that there was a spontaneous retrogression of the gland during the first year.

One frequently sees cases in very young infants who after an initial attack of cyanosis followed by treatment remain as well as other children.

**Physiology.**—The physiology of the thymus is indeed very obscure, little being known about its functions. Its closeness to the thyroid and parathyroid glands and its similarity of origin would almost suggest that it played some specific part in metabolism, but physiologic experiments of late have failed to discover exactly the character of this influence.

During the past few years there has been considerable experimentation which, so far, has apparently cleared up the matter in two directions, namely, the relation of the organ to bone growth and to the condition of the bones, on one hand, and to the electric excitability of the nerves on the other. Basch showed that following complete extirpation of the thymus in a young dog there occurred a softening of the bones and a check to their growth; in fact, a condition very much resembling rickets and chondrodystrophy. At the same time the peripheral nervous system shows an increased electric excitability. Numerous other observers have confirmed these observations, and, in addition, have noted that in thymectomized animals there exists a stage of increased fat absorption and later malnutrition and cachexia.

### STATUS LYMPHATICUS

It is well proved by a long series of cases, carefully studied by competent observers, that the condition known as status lymphaticus is an entity and is characterized clinically by a lowered vitality or an unstable equilibrium of the vital forces, so that accidents or disturbances, otherwise unimportant, such as some slight injury or a light anesthesia, may precipitate failure of the heart and respiration.

<sup>1</sup> Amer. Jour. Dis. of Child., September, 1922.

In status lymphaticus there is hyperplasia of the thymus and general lymphatic gland involvement.

**Etiology.**—A satisfactory explanation of the disease has never been offered. Friedländer found a familial tendency exhibited in 4 families, in that more than one child was affected in each. In two pairs of twins he found the thymus enlarged in each individual. We have never been able to associate the disease with any particular type of child. Likewise the age of the patient is subject to wide variation. Our youngest patient was twelve hours old and another was twenty-four hours old.



Fig. 85.—Enlarged thymus. "The lungs, heart, and thymus are shown in the picture. The lungs have been turned back, showing the two lateral lobes of the thymus overlapping the heart; the central lobe, above, covers the trachea. *History:* Breast-fed, male child, nine months old, well developed; ill less than twenty-four hours; dyspnea, slight cyanosis, with death from asphyxia. T. 103° F. *Autopsy:* Besides the large thymus there were present the general lesions of the status lymphaticus to a marked degree; lungs deeply congested." From Holt's *Diseases of Children*, 1916, D. Appleton Company, Publishers.)

**Pathology.**—The thymus often weighs five to ten times more than normal. In well-marked cases its weight may be as high as 55 gm., and in less pronounced cases range between 10 and 20 gm. As a whole, the hypertrophied thymus is a little more vascular than normal, but, aside from hyperplasia, shows no other consistent changes macroscopically or microscopically.

Autopsy findings in these subjects usually show a general lymphatic enlargement of tonsils and follicles at the base of the tongue and in the

intestine, and swelling and enlargement of the thymus, especially at an age when it has generally disappeared.

**Symptoms.**—These may be almost identical with those of laryngismus stridulus. There are sudden repeated attacks of croupy voice, inspiratory obstruction, cyanosis, apnea, and loss of consciousness which may last from a few seconds to a minute or two. In not every instance is the above sequence of events carried out. The attacks may cease at any stage, or the child may never recover consciousness.

The above clinical picture, with later proved thymic death, has occurred under the writer's own observation several times. On the other hand, the first sign of trouble in two perfectly well-nourished infants was a convulsion and both children died in the seizure. There had never been a previous convulsion or laryngeal stridor. Autopsy in both showed an enlarged thymus.

We have had proved cases in which the manifestations were of a much milder nature. There may be simple stridulous breathing and a persistent croup cough. We have had infants who showed nothing more than so-called sinking spells, characterized by extreme pallor without cyanosis, whose attacks were proven by *x-ray* and subsequent treatment to be due to enlarged thymus.

It is now our custom in any case of respiratory disturbance in a young infant when there is no elevation of the temperature, provided the symptoms are persistent, to subject the child to an *x-ray* study.

**Cause of the Sudden Death.**—The explanation of the deaths occurring in these infants—most frequently during the first eighteen months—is very difficult, and in many cases a careful autopsy does not clear up the situation. Many extraordinary hypotheses have been advanced. Some believe that pressure exerted by the hyperplastic thymus on the vital organs in this region is sufficient to account for the deaths. Others are convinced that the pressure exerted by this gland is sufficient to produce tracheal stenosis, although such a belief seems far fetched when one considers the weight of the thymus and contrasts it with the fibrous tracheal rings.

The occurrence of a sudden swelling has not yet been proved, nor has the theory of a narrowed thoracic outlet, which might be still more narrowed by a forceful extension of the head, received much support. It does not seem possible that such a powerful vessel as the aorta, which is capable of eroding bones, could be pressed upon, with fatal results, as is suggested by some authors.

Many of the sudden deaths occurring during chloroform and ether anesthesia have proved to be due to status lymphaticus.

According to Paltauf's many extensive observations the cause, apparently impossible to explain, lies in a peculiar constitutional anomaly, which makes its possessors weak, and less able to stand attacks of illness, death being easily produced from trifling causes.

Symmers<sup>1</sup> has held that the sudden death may be explained by anaphylaxis due to a process of disintegration of the nuclei of lymphatic tissues with the formation of "nuclear dust" and the release of nucleoproteins. This author also believes that the sudden death may be due to

<sup>1</sup> Amer. Jour. Dis. of Child., December, 1917.

a spontaneous rupture of a hypoplastic cerebral vessel or to rupture following some trivial injury.

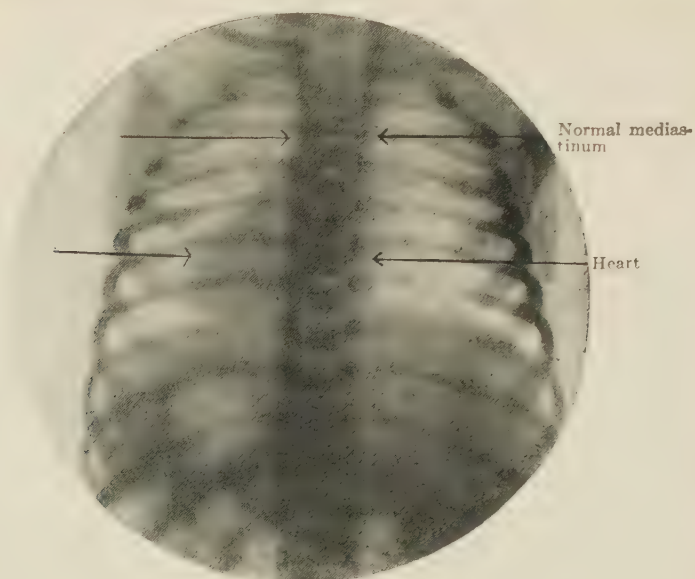


Fig. 86.—Normal thymus.

**Diagnosis.**—In addition to the clinical signs we have the Roentgen ray and percussion to aid us in diagnosis.

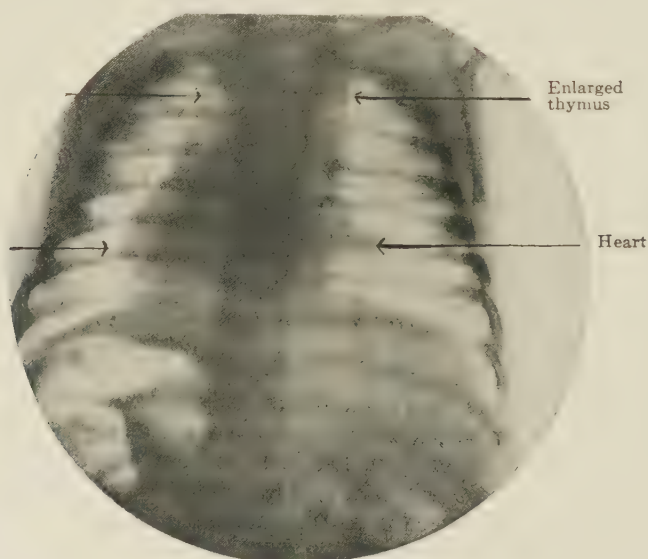


Fig. 87.—Enlarged thymus.

*Percussion* of the thymus has been carefully studied by Blumenreich, and is of much greater value than palpation, although neither of these

methods have received much support in this country. Many instruments have been devised for percussion, but no two men agree on the results obtained.

Blumenreich found the dulness of the thymus to cover a space somewhat triangular in outline, the base being represented by a line drawn across the top of the manubrium between the sternoclavicular joints, while the rounded-off point or apex was found to lie about on a line with the second rib. Between this thymus dulness and the normal cardiac dulness on the left side is a zone normally filled in by lung tissue; if this area be dulled and if all other causes of impairment can be excluded, then a diagnosis of enlarged thymus is justifiable. Among other workers the names of Basch and Rohn may be mentioned. In their outlining of the thymus they found it to be more rhomboid in contour, but, on the whole, tended to confirm the older work of Blumenreich.

*Roentgen Ray.*—A considerable observation of thymus disease with the improved technic of the roentgenologist has led us to believe that in this measure we have an invaluable means of diagnosis. Figures 86 and 87 represent a radiograph by Cole, of New York, in which a normal and an enlarged thymus are shown.

The child was premature and, although nursed by the mother and making satisfactory progress in nutrition, had shown since birth a tendency to attacks of mild cyanosis. Without any illness or the occurrence of anything of a nature to explain the seizure this child suddenly became markedly cyanosed. Respirations ceased and life was despaired of. Under active stimulation and artificial respiration by the trained nurse in charge respiration was with much difficulty re-established. During the next few weeks there were attacks of cyanosis of a less serious nature. Roentgen-ray treatment was then carried out. There were no further attacks of cyanosis and the child made a complete recovery.

A number of the senior author's cases have been similarly treated by Dr. Lewis Gregory Cole, of New York, with most gratifying results.

None of the cases in which x-ray therapy was employed proved fatal, although in some the symptoms were most severe. After five treatments, usually, the child will remain well.

*Surgical Treatment.*—Removal of the thymus has been practised on a limited scale with unsatisfactory results. The mortality is high and with the thymus removed there is the probability of defective growth and development as has been observed in thymectomized animals.

## THE PITUITARY GLAND

The physiology of the pituitary gland is most complex. According to prevailing belief the anterior lobe exerts a specific influence upon body growth while the posterior lobe is concerned in the metabolism of fats and carbohydrates and the secretion of urine. Alterations in the amount of the internal secretion of a part or the whole of this gland are explanatory of surprising departures from the normal in both chemistry and development.

## DYSPIUITARISM. DYSTROPHY ADIPOSOGENITALIS (FRÖHLICH)

This disease represents the manifestation in the organism of diminished function of the anterior lobe of the pituitary gland. The loss of

function, according to Cushing<sup>1</sup> may be due to tumor pressure or disease. This portion of the gland is associated with the metabolism of fat, and with sexual activities, and is closely related with the functions of all the other ductless glands in the body. Sexual infantilism is ascribed to diminished secretions of the pituitary body, inadequate to activate testicular and ovarian functions.

**Symptoms.**—In this disease the patient is short in stature, very fat and with a marked lack of sexual development, the penis and testicles in boys remaining almost infantile in size. There is an absence of pubic hair in both sexes. Boys show decidedly feminine characteristics.

Polyuria and excessive tolerance for carbohydrates are observed. Radiographs of the head may disclose a small sella turcica, indicating a smaller than normal pituitary gland.

Of 6 cases of dyspituitarism coming under personal observation, 5 were those of boys, ranging from eight to sixteen years.

**Treatment.**—The administration of the anterior lobe extract is advised in hypopituitarism. Cushing found that many of these cases have been benefited in the past by thyroid administration, due to an indirect reawakening of the functions of the hypophysis and possible secondary endocrine activities.



Fig. 88.—Nine-year-old boy weighing 94 pounds, with manifestations of dyspituitarism. (Seaside Hospital.)



Fig. 89.—Sella turcica of boy shown in Fig. 88.

The administration of thyroid in small doses,  $\frac{1}{8}$  grain three times daily with 3 grains of anterior lobe extract, has shown no appreciable results in the writer's cases.

#### ACROMEGALY AND GIGANTISM

The first of these conditions is very rare in childhood, but appears closely related to the second in which delay in ossification of the young

<sup>1</sup> Jour. Amer. Med. Assoc., July 24, 1909, p. 249.

skeleton permits of great increase above the normal in the skeletal measurements. Acromegaly occurs after the completion of ossification and is therefore not productive of increase in height characteristic of gigantism. Both abnormal conditions are ascribed to pathological changes affecting the pituitary gland and productive of excessive secretion. Tumor formation of various types may be causative of the abnormality.

One case of undoubted acromegaly involving the bones of the face and particularly the lower jaw has been observed by the senior author in a boy of twelve years.

### DISEASE OF THE PINEAL GLAND

Pineal gland involvement is rarely recognized but has been found due to the presence of cysts, gummata, and tumors. The diagnosis in childhood rests on the association of brain tumor manifestations with those of abnormal and early sexual development of the body, indicated by early growth of hair on the face and genitalia, enlargement of the testicles or breasts, obesity and at times mental precocity. These symptoms contrast markedly with those typical of the pituitary infantilism known as "Frölich's syndrome" (p. 475).

### DISEASES OF THE SUPRARENAL GLANDS

#### ADDISON'S DISEASE

This rare condition is only occasionally observed in childhood and conforms closely to that found in adult life.

**Pathology.**—The typical lesion is some form of tubercle of the adrenal, although other lesions have at times been found. The association of tuberculosis elsewhere in the body is common.

**Symptoms.**—Briefly, these comprise anemia, asthenia, headache, vomiting and other digestive disturbances, and low temperature with the significant added sign of bronze pigmentation of the skin usually involving first the face and hands.

**Course and Prognosis.**—The disease is almost invariably fatal within a few months after the diagnosis is made.

**Treatment.**—The administration of suprarenal gland extract may be tried but is usually ineffective.

### TUMORS OF THE ADRENAL GLAND

Various new growths have been reported of both epithelial and connective-tissue origin. A rare form, known as cortical hypernephroma and exhibiting the cellular characteristics of the tissue of the suprarenal cortex, is productive of marked changes in sexual characteristics, female subjects exhibiting the masculine type of development and males showing precocious development of the male sex character.

### GENERAL DEVELOPMENTAL DISORDERS ATTRIBUTED TO ENDOCRINE DYSCRASIA

#### INFANTILISM AND DWARFISM

The type of infantilism described by Herter has been referred to in the chapter on Intestinal Diseases (page 266).

In dwarfism there is an underdevelopment of all parts of the body, both of the skeleton and of the soft parts. It cannot be doubted that this condition is purely dependent upon a congenital tendency, but the same effects can be produced, at least in so far as the inhibition of growth is concerned, by harmful influences exerted during the period of development and growth. Thus one cannot always tell with certainty whether an abnormal bodily growth is dependent upon a congenital tendency or upon pathologic influences during the period of growth.

A *true dwarf* is a person of small stature, not deformed, whose development has proceeded symmetrically and at a normal rate (except as regards extent) in comparison with other races, families of the same race, or members of the same family. According to Sainton, a dwarf should not exceed 59 inches (1.5 meters). His best illustration is the race of pigmies in Central Africa, whose height is about four feet. In them the dwarfing is not due to any pathologic process. Sexual development, epiphyseal union, and ossification take place at the usual time.

*Symptomatic infantilism* or *dwarfism* is a term used for dwarfism associated with delayed ossification, dentition, and sexual development. It is usually the result of some illness or disturbance of nutrition which interferes with growth. In these cases the body is undeveloped, weak, and slender. Usually there is both mental and physical delay. The common causes are general dystrophies, congenital heart disease, tuberculosis, and syphilis. This condition may also be due to a deficiency of the internal secretions, rickets, spinal caries, and lateral curvature. Another type which is described by Loraine is due to a congenital non-development of the arteries (an angioplasia).

According to Hastings Gilford, *true dwarfism (ateliosis)* is divided into two groups—*asexual* and *sexual*. The subjects are well proportioned, with childish faces and intelligence, irregular and backward teeth, small bones and muscles, and an imperfect sexual system. In the first type the whole body is affected, but the sexual organs are the most backward. The arrest in development may occur at any time of life. There is usually but one subject in a family. The body proportions, contour, and intelligence are those of a child, and the testes are commonly undescended. In sexual ateliosis the development is always delayed until puberty. The epiphyses then unite and the sexual organs mature normally. The child resembles a miniature adult, but retains the physiognomy, proportions, and stature of a child. These patients differ from physiologic dwarfs (pigmies) in the retention of many childish characteristics. Sexual ateliosis is frequently hereditary, and some of the affected individuals may have children with dwarfism of the asexual type, thus suggesting a relationship between the two.

In *progeria* the changes characteristic of senility occur in subjects who are in the adolescent or young adult period of life.

*Cretinism* and *chondrodystrophy* are treated under separate headings. The cases are often classed with those of dwarfs, but do not represent true dwarfism, as the subjects are dwarfed in stature only, and in the cretin growth takes place under thyroid therapy if the case is seen early in life.

## OBESITY

Exceedingly fat children will usually be found to be hearty eaters, of inactive habits. The influence of dysfunction of the pituitary and thyroid in the causation of certain forms of obesity is not to be forgotten.

Obesity is rarely a serious condition, and ordinarily requires little more than certain restrictions in diet, and regularity in exercise. Generally, this is not difficult to obtain, as the patients are usually very anxious to reduce the weight because of the attention they attract and the remarks the condition occasions in public places and among school-fellows.

**Treatment.**—*Diet.*—All fatty foods, including butter and whole milk are to be excluded from the diet. Skimmed milk may be given in moderation—not over one pint daily. A portion of this may be used on the cereal, and the remainder as a drink. The use of sugar, including candy and sweets of all kinds, is to be forbidden. Saccharin may be used dissolved in the milk on the cereal and in making stewed fruits and plain puddings palatable. Green vegetables may be given freely. The evening meal should be very light, consisting usually of broth, a small amount of stale bread, and stewed fruit.

*Exercise.*—During the warmer months golf, swimming, tennis, horseback exercise, and the bicycle are to be advised, a definite time, in hours, being prescribed each day for some active physical exercise. During the cold months roller-skating, ice-skating, horseback-riding, out-of-doors when possible and indoors on inclement days, when the means are at hand, together with long walks, should occupy part of the daily life. A schedule should be prescribed and written out for each day, depending somewhat upon the station in life of the patient, not only specifying the food, but also the outdoor exercise. In this way, under an established system of living covering the entire day, there will result, if the family co-operate, a reduction of the obesity with marked improvement in the patient's general condition.

During the treatment the child should be weighed regularly, as too pronounced results are not desired.

*Drugs.*—The use of thyroid extract and other drugs for the reduction of weight in children is not to be advised.

## THE DIFFERENTIATION OF ENDOCRINE DISORDERS

The subject of endocrinology is still in its infancy and requires consideration in a sphere apart from that belonging to the ordinary pediatric text-book. The facts already presented suggest the extent to which the physician must occasionally go in his consideration of the atypical child before arriving at a correct case classification. For the purpose of facilitating differentiation, the following table is quoted from an exhaustive review by Mark S. Reuben.<sup>1</sup>

<sup>1</sup> Dysendocrinism in Children, Amer. Jour. Dis. Child., August, 1915, vol. x, No. 2, pp. 141, 142. )

TABLE OF VARIOUS CONDITIONS DUE TO DISTURBANCE OF DUCTLESS GLANDS<sup>1</sup>

	Dwarfism.	Skeletal overgrowth.	Skeletal undergrowth.	Premature union of epiphyses and ossification.	Delayed union of epiphyses and ossification.	General hyperplasia.	General hypoplasia.	Sexual precociousness.	Impotence.	Adiposity.	Increased carbohydrate tolerance.	Glycosuria.	Hypertichosis.	Hypotrichosis.	Mental precocity.	Mental dulness.	Hypothermia.	Hypothermia.	High blood-pressure.	Low blood-pressure.	Pigmentation.	A-thenia.	Cerebral symptoms.	Sellar deformation.	Tachycardia.	Tremor.	Spasmophilia.	Polyuria.
Pituitary:																												
Hypersecretion of anterior lobe: types, Marie and Launois.																												
Hypersecretion of posterior lobe: type Froehlich.																												
Hypersecretion of anterior and posterior lobes type, Burnier.																												
Hypofunction of posterior and anterior lobes: type diabetes insipidus.																												
Thyroid:																												
Hypersecretion — Basedow's disease.																												
Hyposecretion — Cretinism.																												
Parathyroids:																												
Chronic hypersecretion, latent tetany.																												
Adrenals:																												
Hypersecretion.																												
Hypersecretion — Addison's disease.																												
Gonads:																												
Hypogonadism — Functio laesa.																												
Hypergonadism — Tumors.																												
Precocious maturity — Functional.																												
Thymus:																												
Hypothyroidism — Status thymolymphaticus.																												
Pineal:																												
Hypersecretion.																												
Pancreas:																												
Hypoparaneatrim — Diabetes mellitus.																												
Plunglandular Disease:																												
Hypersecretion, gonads, para and thyroid hypoadrenals.																												

<sup>1</sup> Reuben, Dysendocrinism in Children, Amer. Jour. Dis. Child., August, 1915, vol. x, pp. 110-147.

## XV. THE UROGENITAL SYSTEM

### THE URINE

**TABLES** dealing with the frequency of urination and the specific gravity of the urine for the different ages of childhood are necessarily inaccurate, particularly when they refer to children under one year of age.

**Urinary Observations.**—At the New York Infant Asylum several years ago Dr. George T. Myers, at that time resident physician, made a series of investigations relating to the various phases and functions of the newborn infant, with results which differed from some of the observations previously recorded. The series comprised 45 cases. Among other observations was one as to the time of the first micturition after birth. It was found that the time varied greatly. In 15 cases micturition occurred simultaneously with birth; in 10, in less than four hours; in 8, in from four to eight hours; and in the remainder, ranged between eight and eighteen hours after birth. In but 2 cases was the interval longer than fourteen hours. It was also found that the specific gravity, the frequency of urination, and the amount of urine passed were subject to wide variations within normal limits depending upon whether the infant was breast fed or bottle fed, whether a girl or a boy, and whether, if the baby was breast fed, the mother had a scanty or a free flow of milk. The bottle fed always passed more urine than the breast fed. The quantity of urine is also influenced by the clothing worn and by the season of the year.

**Normal variations** occur, therefore, within very wide limits. One child will urinate every thirty minutes when awake; others, of equal health and age, will retain the urine for three hours. Before the child takes much fluid, particularly in the first days of life, from 2 to 5 ounces is probably passed in twenty-four hours, with a specific gravity of 1.005 to 1.010. Infants urinating very frequently are apt to develop into bed-wetters in later life, probably owing to the undeveloped condition of the bladder, the size of that viscus remaining small. In other respects, very frequent urination, in the absence of signs of illness, is of no significance in the young. After the feeding is established the specific gravity will range from 1.003 to 1.012 from the second week to the second year. A baby nine months old will pass an average of about 12 ounces of urine in twenty-four hours. At the sixth year, from 16 to 25 ounces with a specific gravity under 1.015 will be passed. From this age until puberty both the quantity and specific gravity gradually increase, the usual range in specific gravity being from 1.010 to 1.020.

**Method of Collecting Urine.**—The collection of the amount voided in twenty-four hours by children of the "runabout" age is difficult, and in young infants well-nigh impossible, except in a metabolism bed. For accurate work the specimen should be obtained by the catheter. When

for any reason this is not possible, there are various devices for collecting the urine, any one of which may be tried. The Chapin urinal and the Spicer<sup>1</sup> urinal are satisfactory forms. The tying on of a wide-mouthed bottle or a condom in boys, fastening it with adhesive strips to the body, is often successful. Absorbent cotton into which the child urinates, the urine being expressed from this into a bottle, may be used for either boys or girls, as may also the Chapin collector. The chief disadvantage of any of these measures is the certainty of contamination. The urine so collected may answer for an examination for albumin, sugar, or the renal elements, but is useless for a bacteriologic study.

**Continence Established.** From the second to the third year continence at night is usually established. If incontinence continues after the third year, the case should be looked upon as abnormal and receive treatment accordingly. (See Incontinence of Urine, p. 484.)

### DYSURIA (DIFFICULT AND PAINFUL URINATION)

Difficult urination is of frequent occurrence in infants and "runabout" children, as a result of scalding at the urethral meatus from irritating urine. The irritation may be due to lack of cleanliness, and in boys with long fore-skins which remain moistened, permitting the urine to decompose in contact with the skin, a considerable degree of inflammation may result. On the other hand, properly circumcised boys may develop a minute ulceration of the meatus urethrae, which shows a tendency to encrustation and may be most annoying. In girls dysuria is often due to hardly discernible inflammation about the orifice of the urethra, occurring in association with vulvitis or vaginitis.

In 2 cases calculi were found in the urethra. Both patients were boys about five years of age.

**Treatment.**—Relief of phimosis and adhesions whenever they exist is strongly indicated, and in most instances circumcision will be found beneficial as a preventive measure. Cleanliness is very essential in all cases, and the saturation of the diapers with boric acid solution before final drying, as recommended by Cooke (p. 102), must be insisted upon for relief of the local irritation accompanying the dysuria of infants. Locally the application of boric ointment or castor oil and balsam of Peru may fulfill all the requirements of a case, but occasionally, where there is actual ulceration, the use of one or more applications of 20 per cent. silver nitrate solution may be necessary.

In all cases of dysuria alkalization of the urine by the administration of sufficient sodium bicarbonate or citrate is advisable, and at times small doses of sweet spirits of niter and tincture of belladonna, frequently repeated, may prove of value.

### SUPPRESSION AND RETENTION OF URINE

In using the above terms with reference to diseases of the urinary organs it is well to appreciate their significance. By *suppression* is meant

<sup>1</sup> Jour. Amer. Med. Assoc., June 5, 1915.

a condition of anuria in which no urine is passed into the bladder, that viscus being found empty on catheterization. In *retention* the urine is secreted by the kidneys and passed into the bladder, but is not voided. When the urine is not voided, we must always ascertain whether there is suppression or retention. If there is retention, this fact may usually be discovered by palpation and percussion. In dealing with fat children a positive diagnosis may be impossible by this means. In the event of doubt a catheter should be employed. For infants under one year of age a soft-rubber, No. 4 or 5 American catheter should be used. The bladder of the infant and young child is very readily infected and care should be exercised to have the catheter sterile. If suppression is diagnosed and treatment by diuretics is instituted, when actually there is simple retention, no little trouble will result.

Suppression of the urine may persist for hours without any grave pathologic condition of the kidneys. Chilling of the skin surface may be a cause. In acute gastro-intestinal disorders with frequent vomiting and watery stools suppression may exist for twenty-four hours. The secretion is re-established when there is again available fluid to be added to the circulation from the digestive tract. If the suppression is due to causes of a grave nature, such as acute nephritis, there will usually be signs of other trouble, such as vomiting, fever, and edema.

Retention may result from an injury to the urethra, or from vaginitis, or from phimosis. Impacted stone in the urethra was a cause in two boys already mentioned. Fortunately, in each case the stone was located near the meatus and readily removed.

**Treatment.**—*Suppression.*—Colon flushing is one of the most effective measures of relieving suppression of the urine. The apparatus required and the methods employed are described on page 857. If the temperature of the patient is not above 102° F., normal salt solution, at a temperature of 110° F., is advised. We have always found flushing more effective when this degree of heat was used. One pint is introduced for a child three years of age. In children of one year or under, from 4 to 8 ounces is all that will be retained. The enema must not be repeated, however, oftener than once in six or eight hours, as the colon of a child soon becomes intolerant of the injections and but little will be retained. Repeatedly, after the first injection, the kidneys have resumed activity when other means had failed.

This method has been particularly useful in cases following or accompanying the exanthemata, when there was an acute nephritis with greatly diminished secretion of urine. A large hot poultice of flax-seed meal about 2 inches thick and sufficiently large to cover the lumbar and lower dorsal regions will often act surprisingly well in re-establishing the kidney function. The treatment should be continued for at least one hour, using three poultices during this time.

*Retention.*—The immediate relief of retention is by catheterization. Further treatment consists in the correction of the exciting cause. If a catheter is not at hand, the application of a hot stupe over the lower portion of the abdomen and the genitals or the administration of a warm saline enema may be sufficient to stimulate urination.

## INCONTINENCE OF URINE (ENURESIS)

In enuresis there is an involuntary emptying of the bladder.

*Enuresis diurna* is the involuntary emptying of the bladder during the waking hours.

*Enuresis nocturna* is involuntary urination during sleep.

Involuntary discharge of the urine is normal in the young infant. Urination becomes a voluntary function at an age depending largely upon the child's training. In most children, with the right kind of management, the function may be controlled during waking hours by the tenth month.

During sleep, involuntary urination continues to a later period, and, while in many perfect control may be established at the completion of the second year, one need not regard the lack of control as abnormal until the third year is completed. If, during the second year, the child shows a tendency to frequent urination and involuntary passage of urine during the waking hours, with habitual incontinence at night, it is important to advise preventive measures.

When the incontinence persists during the waking hours at the completion of the second year, or during sleep at the completion of the third year, the condition is to be regarded as abnormal and the child placed under treatment.

**Etiology.**—*Deformities and Abnormalities.*—The condition may be due to a congenitally small bladder, with very little holding capacity.

A girl who came under treatment for incontinence by day and night had a bladder the holding capacity of which was but one ounce.

With such lack of development of the bladder, obviously there must be incontinence. In spina bifida it may occur as a result of paralysis of the pudic nerve supply to the neck of the bladder. x-Ray in some instances of incontinence will reveal an unsuspected *incomplete* spina bifida without external evidences. A congenitally large urethra may also be a cause.

*Peripheral causes* acting through reflex irritation are not infrequently encountered. Thus, incontinence may be due to a vaginitis, to an adherent clitoris, or to phimosis. Other possible causes are thread-worms in the rectum, constipation, stone in the bladder, cystitis, and hyperacidity of the urine.

The diet may also play a part. The use of highly nitrogenous food in large amounts or a diet rich in sugar may lead to changes in the urine sufficient to cause the trouble.

Excessive bed-clothing and the habit of sleeping on the back have a bearing in the causation.

Adenoid vegetations in considerable amount in the nasopharyngeal vault are looked upon by some authors as an etiologic factor.

Children afflicted with diabetes insipidus, polyuria, or diabetes mellitus, because of the large amount of urine passed, are very apt to suffer from incontinence.

Weakness of the sphincter is supposed to play a part in causing incontinence, particularly loss of control when awake.

*Cases of Nervous Origin.*—The nervous control of the bladder is dependent upon a cerebral center and a sacral center, each receiving and sending out impulses.

It is not difficult to understand how a lack of co-ordination from faulty development of the sympathetic mechanism might occasion incontinence. After all possible dietetic errors and irritations acting reflexly through the above nerve mechanism are excluded, about 90 per cent. of our cases remain unexplained. This group represents the cases usually chronicled as due to a neurosis or absence of co-ordination due to failure of sufficient development of the nerve centers.

**Diagnosis.**—The patient always has a ready-made diagnosis.

**Prognosis.**—The prognosis depends largely upon the physician and the child's parents or attendant. Great patience and persistence are necessary. All cases are curable except when an anatomic abnormality exists. In many instances the response to treatment is very prompt. In others it is tedious, several months being required before we are sure that the cure is complete.

A fact to be taken into consideration in making a prognosis as to the probable duration of the treatment in a given case is the size of the bladder, since a child who has suffered from incontinence both by day and night may have a small and contracted bladder, because of lack of development from disuse. The most reliable means of determining the size of a bladder is by measuring the amount of sterile water which can be introduced through a catheter.

**Treatment.**—In assuming the care of a child with enuresis, obviously it is most necessary to learn the cause of the trouble. Two or three examinations of the urine should be made, and if it is found persistently acid and of a specific gravity over 1020, a reduction in the nitrogenous food-stuffs is necessary before beginning medication. If the enuresis is due to peripheral causes, they must be corrected and the general physical condition of the child improved, although in our experience the delicate and chronically ailing are not the children who are the greatest sufferers, by far the larger number of such patients having been well-nourished children who were otherwise normal. Long-continued incontinence does not appear to affect the general health. The condition, if untreated, usually continues until the child is eight or ten years of age. We have known of a few cases which persisted until puberty, or later.

If no improvement follows the removal of all possible dietetic and extrinsic causes—as acidity, phimosis, worms, constipation, etc.—we must assume that we have an idiopathic incontinence to deal with. If the case is one of nightly incontinence of several months' or years' standing, we must positively acquaint the mother with the fact that prolonged treatment will in all probability be required, and that unless her active and continued co-operation is assured the treatment of the case will not be undertaken.

With the very definite understanding that no brilliant results are immediately expected, the following scheme of management is inaugurated: The child receives three meals daily. The breakfast and dinner correspond to the age of the child, but with the important exception that red meat is to be given but once during the twenty-four hours, and

only at midday. The supper, which should not be later than six o'clock, we designate as a "dry supper." It may consist of any cereal, such as rice, hominy, farina, or wheatena, served with butter and sugar. If this is not well taken, a small quantity of both sugar and milk may be added. Permissible articles for the evening meal in addition to the above are ice-cream, milk toast, blanc-mange, raw fruit, jelly, stewed fruit, bread and butter, junket, and cornstarch. Meat, eggs, or heavy foods of any kind should not be given at night.

*Abstinence from Fluids.*—At 4 o'clock in the afternoon the child may be given a half-glass of water or milk, but after this time no fluids are to be allowed other than a scant ounce of milk on the cereal. The withdrawal of all fluids after 4 P. M. will at first be a hardship for some children, and they may be allowed 3 or 4 ounces of milk or water with the evening meal; but this quantity should gradually be diminished until at the end of a week it will not be missed.

*Night Management.*—The patient should be as lightly covered at night as comfort will permit. There is less tendency to incontinence if the child rests on the side or stomach, and sleep in this position should be encouraged. In dealing with inveterates, for whom every possible aid is brought into use, one may use the knotted towel as a means of keeping the child off his back. The towel, knotted in the middle, is passed around the child so that the knot will rest on the back. The ends of the towel should then be pinned together over the abdomen like those of an abdominal binder. When the patient attempts to rest on the back the knot causes discomfort and the position is changed. At 10 or 11 o'clock, when the person in charge retires, the child should be taken up to urinate.

*Drugs.*—Without a strict observance of these regulations, particularly those relating to diet and abstinence from water after 4 P. M., drugs are of no value, whatever their method of administration. With the above suggestions carried out, we have one remedy which is of real value, and that is belladonna. For convenience of administration we prefer the alkaloid, atropin. To insure full benefit in severe cases the drug must be pushed until the physiologic effect is obtained, as shown by slight dilatation of the pupils. Before beginning the treatment it is well to advise mothers that redness of the face need cause no alarm, but calls for the discontinuance of the drug until further instructions are given. The atropin is administered in a solution of one grain to an ounce of water; 1 ounce of water contains approximately 500 drops, so that 1 drop of the atropin solution will contain approximately 1/500 grain of the drug. The mother is given a chart containing the directions for administration, which for a child five years of age are as follows:

Day.	4 P. M.	7 P. M.
1st.....	0 drop	1 drop
2d.....	1 "	1 "
3d.....	1 "	2 drops
4th.....	2 drops	2 "
5th.....	2 "	3 "
6th.....	3 "	3 "
7th.....	3 "	4 "
8th.....	4 "	4 "
9th.....	4 "	5 "
10th.....	5 "	5 "

The maximum dose given is 1 drop daily at 4 and 7 P. M. for every year of age. Thus, for a child three years old the dosage should not be greater than 3 drops, twice daily; for a child six years old not over 6 drops, twice daily. It may be well, if the case is not under close observation, to make a more gradual increase in the dosage, so as to avoid the possibility of unpleasant physiologic effects.

It is never necessary to exceed these doses even with older children, for the reason that the amounts given are ordinarily sufficient to control the enuresis; and the dilated pupils and belladonna blush which follow an increased dosage show that such increases are imprudent.

The tolerance of atropin varies considerably, although children usually bear it very well. Now and then a child is treated who cannot take more than 2 drops (1 250 grain) daily. To one boy eight years of age but 1/200 grain could be given twice daily.

Pronounced benefit, ordinarily, will not be observed during the first week or two of treatment. If the child suffers from incontinence while awake, this, ordinarily, will first be cured. The improvement in nocturnal incontinence is more gradual and may be considerably delayed. Thus, no improvement whatever may be seen for two or three weeks. In the average case the improvement is gradual. At first there will be nights at short intervals when there will be very slight incontinence, or none at all. Usually, after a few weeks' treatment the incontinence entirely ceases.

The mistake frequently made is to stop the atropin at this point. When this is done there is usually an immediate return of the trouble. The full treatment should be continued until the child has not wet the bed for at least two weeks. The daily amount of atropin should then be reduced one-half and kept at this point for six weeks. If at the end of two months from beginning treatment there is no incontinence, the drug may be discontinued, but the dietetic restrictions, particularly the "dry supper," should be maintained three months longer. It must be remembered that the habit which has become established is hard to overcome, even after the neurosis and the weakness of the sphincter have been corrected.

Strychnin and tincture of cantharides have been advocated by pediatric writers. For weak, poorly nourished children strychnin added to iron or cod-liver oil may be of service in improving the general condition of the patient, and indirectly aid in the treatment of the enuresis.

When incontinence occurs only during the day, the dietetic regulations are the same as those given, with the exception that the fluids allowed need not be curtailed unless the quantity is excessive. The dosage of atropin is the same, but the time of administration should be changed to after breakfast and after luncheon, instead of at 4 and 7 P. M. In addition to the atropin, strychnin should always be given in cases of incontinence by day, for in such cases a lack of development or a relaxation of the sphincter is more of a factor than is failure of nerve co-ordination.

#### HEMATURIA (BLOOD IN THE URINE)

The presence of blood in the urine may be due to readily discernible causes; or when small (microscopic) amounts are present, the cause may be most difficult to determine.

Highly concentrated urine may be sufficiently irritating to produce the passage of microscopic amounts of blood. Blood and albumin are not of infrequent occurrence in the urine of the newborn and during the first weeks of life, because of the presence of uric acid in large amounts peculiar to this period of life.

Among the possible causes of blood in the urine are:

Acute nephritis.

Hemorrhage neonatorum.

Hemophilia.

Purpura hæmorrhagica.

Scurvy.

Trauma.

Calculi.

Malignant growth of the kidney.

Tuberculosis of the kidney or bladder.

Certain drugs taken into the stomach.

### HEMOGLOBINURIA

In this condition the urine contains the coloring-matter of the blood, with few, if any, corpuscles. There may be a small amount of albumin. The urine may be light red, brown, or even black.

In a child one year old who died from creosote poisoning the urine was almost black, the color being only in part due to the salts derived from the drug.

In another case of a child three years of age with malaria the urine was of a deep brown color.

*Paroxysmal hemoglobinuria* is of very rare occurrence in this country. In tropical countries, where severe forms of malaria are common, the condition is not unusual. It is due to some toxic agent which dissolves the coloring-matter out of the blood. Syphilis is one cause.

### PYURIA

Pus in the urine in the young is usually the result of a pyelocystitis or pyonephrosis. (See pp. 505 and 491.)

*Illustrative Case.*—A hospital patient, about eighteen months of age, showed periodically large amounts of pus in the urine. Pus would be present in the urine for a few hours, and then, for two, three, or more days, the urine would be perfectly clear and free from pus.

Autopsy showed that although one kidney was normal, the other had undergone cystic degeneration, the pelvis being greatly dilated and filled with pus. The ureter was thickened and partially occluded. When the sac had become filled with pus, and the child was in a favorable position, the pus promptly discharged into the bladder.

Pyelonephritis may be the result of a pyelocystitis.

*Illustrative Case.*—A child eleven months of age had pyelitis, evidently primarily, which had not been recognized. The temperature ranged very high—105° to 107° F.—and the child died from exhaustion and anemia. Autopsy revealed an extensive pyelitis with multiple abscesses scattered throughout the kidney structure, varying in size from a pin-point to a pea.

Such cases as the foregoing, it is understood, are of very unusual occurrence. In still rarer instances the pus may be due to an abscess

(phrenic or of another type), which may open into the urinary tract. When pus is present in the urine, the source is usually the bladder (cystitis) or the pelvis of the kidney (pyelitis).

Specific urethritis (gonorrhea) will give rise to pus in the urine. Gonorrhea, however, is of very unusual occurrence in boys, and when present, is sufficiently active to leave no doubt as to the nature of the trouble.

### GLYCOSURIA

Temporary glycosuria or dietetic glycosuria is of frequent occurrence and little significance. This condition usually means that more carbohydrate is being taken than can be cared for by the economy, and with a discontinuance of the excessive intake the sugar disappears from the urine.

*Illustrative Cases.*—In a series of observations made several years ago at the Country Branch of the New York Infant Asylum, 10 children were selected for high-sugar feeding, and 10 per cent. sugar mixtures were given to those under one year of age. Every case showed glycosuria after twenty-four hours of this feeding.

Two most interesting cases of persistent glycosuria without any other manifestation of illness have been under observation for over twenty years. That sugar existed in the urine of both patients was discovered by accident. How long the sugar may have been present we have no means of knowing. The mother, an unusually careful woman, conceived the idea that it would be wise to have the urine of all her 4 children examined, and greatly to the writer's surprise it was found that two specimens, one from a boy of four years, the other from his brother of six, contained a large amount of sugar, 3 and 3.5 per cent. respectively. A careful examination was at once made of both patients, but revealed nothing abnormal. The children were strong; there was no unusual thirst and no polyuria, and, further, the examination of the urine failed to reveal the presence of either acetone or diacetic acid. They were placed on a rigid antidiabetic diet (p. 787), which reduced the sugar to 1.5 and 2 per cent. respectively. During the fifteen years thereafter the boys made satisfactory physical and mental progress, attending school regularly, except when prevented by the usual ailments of childhood. Both underwent operation for adenoids and enlarged tonsils, under ether anesthesia, with no more than the usual discomfort. They made normal increase in stature, weight, and strength, and are perfectly normal in appearance. During these years monthly examinations were made of the urine. There was never less than 1.5 per cent. of sugar in any specimen, the sugar rarely being below 3 per cent. or above 6 per cent.

The condition persisted in spite of the most careful diet, always without the association of polyuria or extreme thirst. The children were seen by several consultants in New York City, and were at one time under the treatment of three well-known specialists in Germany. Acetone has been found in the urine of one.

Probably every variety of treatment which might be expected to exert an influence on the sugar production was tried for protracted periods without exerting a particle of influence in reducing it. Indiscretions in diet increase the sugar; otherwise it varies as stated above. None of the physicians here or abroad who treated the boys has seen similar cases.

The cases here cited in detail are of much interest as showing the inefficacy of medication and the effects of diet in glycosuria, and, furthermore, as presenting a clinical picture which is most unusual. It has been suggested that the glycosuria in these cases may be due to some persistent and unusual toxemia from intestinal sources or to abnormal metabolism from disordered pituitary function. Blood chemistry at the present is of immense value as applied to cases presenting such problems. Case studies today are particularly influenced by fuller understanding of the biochemic rôle of the pancreas, and growing appreciation of the remarkable potency of insulin. (See page 786.)

## THE KIDNEYS

## TUBERCULOSIS OF THE KIDNEY

Tuberculosis of the kidney is usually secondary to tuberculosis existing elsewhere in the body. Primary cases, however, have been reported.

**Lesions.**—In general tuberculosis miliary tubercles are scattered throughout the kidney. In other forms there are nodular lesions, or foci of caseation which may break down, resulting in the formation of cavities.

**Symptoms.**—The symptoms of the disease are progressive weakness and emaciation, attended by a low grade of fever. In many instances the affected kidney is enlarged and palpable. Frequency of urination is a characteristic symptom, and the urine may contain albumin, blood, or pus. The presence of blood for a considerable period in urine of normal specific gravity containing no casts is strongly suggestive of tuberculosis of the kidney. The finding of the tubercle bacillus in the centrifuged urine substantiates the diagnosis. Catheterization of the ureter is of value in demonstrating whether one or both kidneys are involved.

**Prognosis.**—The prognosis is unfavorable.

**Treatment.**—Tuberculin therapy, in careful hands, may be of value. In all cases heliotherapy and the routine supportive treatment followed in other forms of tuberculosis should be employed. When one kidney remains normal, the best results are gained by surgery involving extirpation of the diseased organ.

## NEW GROWTHS OF THE KIDNEY

**Non-malignant** new growths of the kidney are uncommon. *Adenomata* and *fibromata* are occasionally encountered. The adenomata are either papillary or cystic, and are encapsulated by connective tissue. These growths appear as small, light colored nodules, and, microscopically, present an alveolar or tubular structure. Fibromata exist as white, nodular masses, usually not over  $\frac{1}{4}$  inch in diameter. They are imperfectly differentiated from the interstitial connective tissue of the kidney.

**Malignant.**—*Adenosarcomata* and *adenocarcinomata* are two forms described in the literature. Herringham<sup>1</sup> has emphasized the fact that the degree of malignancy of such growths cannot be accurately determined from their histologic structure.

Malignant neoplasms of the kidney are more common before the fifth year of life than in any succeeding decade.<sup>2</sup> These tumors have been classified as *carcinomata* and *sarcomata*. Most of the growths, however, are atypical mixed tumors of embryonic origin, and may contain striped muscle, cartilage, and lipomatous or fibrous connective tissue. To such forms the term *rhabdomyosarcoma* has been applied.

The *hypernephroma* is derived from suprarenal tissue, which may be included in the developing kidney. This tumor is subject to great variations in size and structure, and may resemble sarcoma, adenoma, carcinoma, or perithelioma. The growth characteristically contains pig-

<sup>1</sup> Kidney Diseases, 1912, p. 309.

<sup>2</sup> Herringham on Statistics of Morris, Kidney Diseases, p. 311.

ment, which is identical with that found in the adrenal. Not infrequently the hypernephroma becomes cystic.

**Symptoms of Renal Neoplasms.**—Malignant growths of the kidney often attain an enormous size, half filling the abdominal cavity and displacing certain of the contained organs. The abnormal mass is usually movable and occasionally communicates pulsations from the subjacent aorta. The edges of the tumor are more rounded than those of an enlarged spleen or liver, and the anterior surface is less closely related to the ribs. Apart from the local physical signs, the patient may exhibit no significant symptoms. Nutrition, however, is generally impaired, and in many instances the tumor occasions dragging pain and hematuria.

**Prognosis.**—In untreated cases the course of the disease is progressive and its outcome fatal. Metastases, however, are of relatively slow development, and are preceded by involvement of the veins closely related to the growth.

**Treatment.**—Nephrectomy is the only treatment of value, and even this is useless when multiple metastases have occurred.

The majority of the cases which undergo operation develop malignancy in the remaining kidney within a year or so after the operation.

A very exceptional case was that of a two-year-old girl, a patient at the Babies' Hospital in New York City. From this child Dr. Robert Abbe removed a large kidney sarcoma. The recovery was complete, and the patient became a perfectly well young woman.

#### HYDRONEPHROSIS AND PYONEPHROSIS

*Hydronephrosis* is a condition characterized by distention of the pelvis of the kidney with an accumulation of urine. With an invasion of the contained urine by the colon bacillus or other pathogenic organisms, *pyonephrosis* may develop.

**Etiology.**—A few cases of traumatic hydronephrosis have been reported. Ordinarily, however, the disease develops as the result of some obstruction in the urinary tract, either congenital or acquired.

Congenital hydronephrosis may be due to an angular junction of the ureter with the pelvis of the kidney, septa or valves in the ureter, an abnormally small ureterovesical orifice, twisting of the ureter by a floating kidney, or an imperforate urethra.

Acquired hydronephrosis may be occasioned by inflammatory stricture of the ureter, an obstructing calculus, or external pressure on the ureter by a neighboring tumor.

**Pathology.**—The ureter is dilated and perhaps sacculated above the site of the obstruction. The kidney is usually, but not invariably, enlarged, and on section will be found to be structurally deficient and more or less cirrhotic. The contained fluid resembles normal urine, but contains a relatively small amount of urea. In long-standing cases the kidney may become infected and undergo suppurative inflammation. In such instances the fluid contents become purulent and the condition resolves itself into pyonephrosis. In fact, in all the writer's cases which came to autopsy—3 in number—a pyonephrosis was present. Usually one kidney only is involved.

In two of these cases both organs were affected, the pelvis being so dilated as to be almost unrecognizable. In a newborn babe who died in five days both kidneys were enlarged, soft, and easily palpable.

Chronic diffuse nephritis is frequently associated with hydronephrosis.

**Symptoms.**—The significant manifestations of “dropsy of the kidney” are localized pain and tenderness, a fluid tumor in the kidney region, and scanty urination, which may be interrupted at intervals by the discharge of urine of low gravity in more than normal amount. In doubtful cases aspiration of the fluid from the tumor may facilitate the diagnosis. Pus is usually present in the urine, and through cultures the nature of the infection may be learned.

**Prognosis.**—Children suffering from bilateral hydronephrosis die in early infancy. When the condition is unilateral, the patient may survive, provided the unaffected kidney is normal.

**Treatment.**—Prophylactic doses of urotropin have been administered to forestall possible suppuration. Surgery, however, offers the best possibilities, and the only operation of permanent value is nephrectomy.

*Illustrative Case.*—An infant presented very puzzling symptoms. There was a periodic discharge of large amounts of urine, containing free pus, casts, and epithelial cells. The phenomenon occurred about every second or third day. Between times specimens of the urine obtained by catheter were normal. The child died from malnutrition and marasmus. At autopsy one kidney was found normal. The other showed a typical dilated hydropyonephrosis, with the upper two-thirds of the ureter dilated, sacculated, and thickened. In the lower portion there was a congenital constriction with angulation which gave way when the pressure from above became pronounced and the kidney contents were evacuated.

### CYSTS OF THE KIDNEY

Cysts of the kidney are usually congenital, due to defective embryonic development. These cysts occur in that portion of the organ which is developed from the metanephros. They are almost always bilateral, and are usually associated with a process of fibrosis which replaces a variable amount of the parenchyma of the affected organ. In many of the patients other congenital malformations coexist.

Retention cysts occasionally arise from obstruction along the courses of the uriniferous tubules, and secondary cystic degeneration may be induced in a kidney which is the seat of a destructive primary disease. Hydatid cysts develop occasionally as the result of echinococcus invasion.

Many infants with congenital cysts of the kidney die in the first year of life.

**Symptoms** of the diseased condition are unapparent, or else are confined to the local signs of tumor, and such manifestations of urinary retention as edema and uremic convulsions. Wyeth held that it was a safe rule to aspirate the contents of a renal tumor which was large enough to be appreciated by palpation and inspection. If this be done, the fluid from congenital cysts will be found to resemble that from a hydronephrosis, that from a hydatid cyst will show the presence of hooklets, and that from an organ undergoing cystic degeneration will be found to be highly albuminous.

When **treatment** of cyst of the kidney is justifiable, the procedure must be surgical.

## THE VARIOUS FORMS OF NEPHRITIS

For many years it has been customary to classify the various diseases of the kidney associated with albuminuria and dropsy and commonly designated "Bright's disease" under separate headings to meet the dissimilar views of clinicians and pathologists. The problem existing in this situation has recently been to a large extent solved by the growing tendency on the part of various observers to adopt the classification of Volhard and Fahr.<sup>1</sup>

In this classification the degenerative kidney conditions are designated as nephroses; the inflammatory, by the term "nephritis"; and the arteriosclerotic processes, which are more frequent in adult life, as scleroses.

The following tabulation includes the ordinary nephropathies belonging to childhood and conforms closely to the classification of Volhard.<sup>2</sup>

- A. Nephroses: Degeneration diseases without definite inflammatory lesions:
  - 1. Acute nephrosis ("parenchymatous nephritis").
  - 2. Chronic nephrosis.
- B. Nephritides: Inflammatory diseases:
  - 1. Diffuse glomerulonephritis:
    - (a) Acute.
    - (b) Chronic.
  - 2. Focal nephritis:
    - (a) Focal glomerulonephritis.
    - (b) Septic interstitial nephritis.
    - (c) Embolic focal nephritis.
- C. Scleroses: Arteriosclerotic diseases:
  - 1. Benign hypertension. Pure arteriosclerosis of the kidney vessels.
  - 2. Malignant hypertension. Sclerosis plus nephritis ("interstitial nephritis").

The conditions commonly termed "acute parenchymatous nephritis," "chronic parenchymatous nephritis," "glomerulonephritis," and "interstitial nephritis" are to be readily identified in this scheme. The present-day narrowing application of the terms "nephritis" and "Bright's disease" should be better appreciated by the clinician.

Four groups of nephritis in children have been described by Schwartz and Kohn.<sup>3</sup>

In Group 1 were included the cases in which edema was the outstanding feature, developing without apparent cause and accompanied by little if any fever. This condition represents a nephrosis or "parenchymatous nephritis."

In the cases of Group 2 the onset was acute with or without accompanying acute disease and the course was frequently febrile with hematuria. These cases exemplify the various forms of nephritis grouped under heading B in the above tabulation.

In Group 3 were included cases of long duration without outward signs of kidney disease, but subject to occasional acute manifestations. Heubner<sup>4</sup> has used the term "paedonephritis" to describe the condition to which the prolonged cases of Group 3 apparently belong.

To Group 4 were assigned cases presenting the symptoms of vomiting,

<sup>1</sup> Tice, *Practice of Medicine*, vi, p. 587, 1921.

<sup>2</sup> *Die Doppelseitige Haematogischen Nierenkrankheiten*, Berlin, 1918.

<sup>3</sup> *Studies of Nephritis in Children*, Amer. Jour. Dis. of Child., 24, p. 125, August, 1922.

<sup>4</sup> *Kinderkrankh.* Ed., 3, 2, p. 502.

polyuria, hypertension, retinitis, and convulsions, conforming to the adult picture of malignant hypertension or "interstitial nephritis."

Chronic diffuse nephritis of the type found in adults and conforming to the conditions designated by the term *sclerosis plus nephritis* has been considered by Carl H. Greene<sup>1</sup> to depend on a congenital origin.

In Chapter XXIII (p. 828) are considered tests for renal function too often not employed by the practitioner in making a diagnosis of "nephritis." These procedures together with those of a purely therapeutic character, discussed in Chapter XXIV, are essential to the proper handling of individual cases.

#### ACUTE PARENCHYMATOUS NEPHRITIS (ACUTE DIFFUSE NEPHRITIS)

Nephritis, in common with many other ailments of children, may be either mild or severe. It may be so severe as to cause death in a few hours, or so mild as to pass unrecognized. In cases often classed as primary, nephritis probably is the sequel of unrecognized scarlet fever, tonsillitis, or acute mastoiditis. In recent years we have seen more cases in association with tonsillitis and mastoiditis than with scarlet fever, perhaps for the reason that in late years scarlet fever has been of a milder type than formerly.

Three apparently primary cases were those of young infants three and four months of age in whom no previous disease had existed. All were institution children, and all the cases came to autopsy.

**Etiology.**—In an immense majority of cases acute nephritis occurs as a complication of the acute infectious diseases. Nephritis is more frequently associated with scarlet fever than with any other ailment of childhood. We have observed acute nephritis complicating or following scarlet fever, diphtheria, tonsillitis, parotiditis, adenitis, measles, malaria, influenza, varicella, general sepsis, and acute intestinal infection.

**Effects of Different Toxic Agents.**—Acute inflammation of the kidneys is caused by chemical or bacterial irritants. In the course of any local or general infection toxins or bacteria, or both, are excreted by the kidneys, and may cause degeneration or inflammation of these organs. Thus pneumococci may be isolated from the urine in the course of a nephritis complicating pneumonia, typhoid bacilli during typhoid fever, and streptococci during any streptococcal infection. The bacteria are also found in the kidney at autopsy. The diphtheria toxin, and not the bacillus itself, is the cause of postdiphtheric nephritis.

Suppurative inflammation of the kidney may be of hematogenous origin due to any one form of the pyogenic cocci, or it may be caused by an ascending inflammation from the bladder, ureter, and pelvis of the kidney. The latter condition is a pyelonephritis, and its almost invariable cause is *Bacillus coli communis*.

Nephritis may develop at any time during the active stage of scarlet fever. It is rare before the third week, and it may be delayed for several weeks after. Cases not infrequently develop after the sixth week. Nephritis has been known to appear as late as three months after the acute

<sup>1</sup> Chronic Diffuse Nephritis in Childhood, Amer. Jour. Dis. Child., March, 1922, vol. 23, No. 3, p. 209.

symptoms of the primary disease have subsided. The severity of scarlet fever bears but little relation to the development of nephritis or the time of such development. In consultation practice a previously undiagnosed illness, with rash or stomach disturbance, has repeatedly been discovered to have been scarlet fever by the sequela of nephritis.

**Pathology.**—The changes which occur in the kidney may be predominantly exudative or productive in character, and may affect the parenchyma most severely, or be fairly well limited to the interstitial tissue. Digression for comparison is accordingly here made.

In ordinary acute nephritis of the *parenchymatous type* the organ is enlarged, of decreased consistence, and on section presents a dull gray cortex, the capsule of which strips easily. There is a more deeply congested medulla. Structural markings are obscured, although occasionally the glomeruli stand out on the cut surface as scattered reddish spots. Microscopically the parenchyma is found to be the seat of granular degeneration and exfoliation, so that the tubules have become dilated with necrotic cell products, casts, and free blood-corpuscles, the amount of blood depending on the degree of congestion in the vessels of the glomeruli. The kidney stroma is edematous and may show considerable cellular infiltration and proliferation. Proliferation of the cells lining the capsule of Bowman is also common.

Shennan has stated that the degenerative changes in the kidney depend on the nature of the causative toxin and its concentration, some toxins producing chiefly catarrhal changes, while others cause cell necrosis. The urine under the conditions described, although decreased in amount and containing albumin and casts, may, nevertheless, be of low specific gravity due to diminished excretion of urea.

In acute nephritis of the *interstitial type*, which is much less frequent, the urine may be free from pus, casts, and albumin. More often, however, this condition does not obtain, as the nephritis is secondary to a general pyemia or part of an ascending pyelonephritis, in which case the tubules microscopically show evidences of marked degeneration in addition to the more apparent process, an infiltration of the connective tissue with polynuclear cells.

In a late nephritis of the interstitial type the development of fibrous tissue with atrophic changes in the glomeruli may possibly render the diseased organ smaller and firmer instead of larger and softer than normal.

In the typical diseased *kidney of scarlet fever* there is a very characteristic glomerulonephritis, marked by a proliferation of the epithelial and endothelial cells lining the capsules and on the tufts, and by an extensive round-cell infiltration of the tissue about the glomeruli. A severe attack of renal congestion during the febrile period of scarlet fever does not ordinarily become chronic; but a glomerulonephritis, slow in onset and of the productive type, may cause death from acute suppression of urine during convalescence, or perhaps terminate in chronic nephritis.

**Symptoms.**—Acute nephritis may exist, run a mild course, and terminate favorably without symptoms. That this occurs in many instances is beyond doubt.

Usually the first symptom noticed is a slight puffiness (not edema) about the eyes. A similar puffiness of the fingers and the ankles occurs,

and the backs of the hands, as well as the ankles, soon become edematous. The skin becomes pale and of peculiar waxy whiteness. The patient exhibits loss of appetite and nausea, and sometimes vomits. Mild frontal headache is a frequent symptom. As the case progresses the peculiar pallor increases, the face becomes very much swollen, the eyes almost closed, and the legs and the feet increase very much in size and develop a cushion-like appearance and consistence. The subcutaneous tissue over the back and abdomen becomes infiltrated, and the whole aspect of the body is changed. There is a smoothing out of the folds and angles, giving a decidedly rotund appearance. As the result of such a general edema the child increases very much in weight. A child weighing 40 pounds may increase in weight one-third. We have seen an increase of 15 to 20 pounds in not a few cases.

In children one would invariably look for the more active symptoms, headache, vomiting, and prostration, but in many instances these symptoms are not prominent.

*Fever.*—An elevation of temperature usually exists in all cases, but is not necessarily high. Although a fever of 103° to 105° F. is of occasional occurrence, the usual temperature range is from 100° to 103° F. The temperature, as a rule, is not of long duration unless the case is to have a fatal termination. A continuous high temperature is an unfavorable sign.

*The Urine.*—In every case of scarlet fever—in fact, in all infectious diseases—the urine should be examined daily, as recommended under the subject of management. Time and again we have known cases showing a moderate amount of albumin and casts, with a few blood-cells, to clear up entirely under treatment. If these cases are not recognized and properly treated, a large proportion go on to develop the more serious characteristic signs of the disease.

The first objective sign will be scantiness of the excretion of urine. The urine voided will be reduced from a total daily quantity of 30 to 40 ounces to only 10 or 15 ounces. Later a very few ounces only may be excreted, or the urine may be completely suppressed (anuria).

The color becomes very dark, and if blood is present the urine will show a decidedly smoky appearance. Blood may be present in such large amounts as to give the appearance of pure blood.

*Uremia.*—In very severe cases uremic convulsions may occur. Severe headache and repeated vomiting, with scanty urine and deficient excretion of urea, are indications that uremia exists.

*Convulsions.*—The convulsion comes on suddenly and is typically bilateral. It may last but a few minutes, or it may last for several hours. The child may die in convulsions.

*Fulminating Cases.*—A form of acute nephritis which deserves particular attention occurs early in malignant scarlet fever. The onset is very abrupt. But little urine is passed, and this is filled with albumin, casts, and blood.

*Illustrative Case.*—In a severe case complete suppression occurred without previous warning, and the child died in thirty-six hours, the duration of the entire illness being but seventy-two hours. There was no edema. The patient became comatose, and died from the uremia and the intense scarlatinal poisoning.

**Duration.**—The duration of an attack depends largely upon the severity. Exceptionally patients have become well in one week, while in other cases the urine was not free from albumin and casts for six weeks and sometimes longer. In case of apparent recovery one should not look upon the patient as fully recovered until twelve months have elapsed, and should not allow a child who has had well-marked nephritis to pass from observation within less than one year. A peculiarity of nephritis is its tendency to return. The chronic cases which we see almost invariably give a history of two or more acute attacks at intervals perhaps of several months. The second and subsequent attacks might have been prevented by proper protection and care.

It may, therefore, be put down as a fact that chronic nephritis in a child often means neglect as much on the part of the family as on the part of the physician.

**Prognosis.**—The prognosis of severe acute nephritis is good if proper management is carried out from the beginning of the illness until at least one year has elapsed. The prognosis is bad in even a mild case if it is neglected. Nephritis is one of the diseases in which right management is most essential, even in very mild cases.

**Diagnosis.**—That nephritis is present is indicated by the appearance of swelling about the eyes and ankles, or by a more active onset of vomiting, fever, and headache.

Suspicion in any given case may be easily verified by a urine examination.

**Examination of Urine.**—If, during scarlet fever or any of the infectious diseases, the physician takes the precaution of having nitric acid and a few test-tubes at the home of the patient so that the urine may be tested for albumin at each visit, in addition to a reasonably frequent microscopic examination at the office, nephritis may be detected before the more active clinical signs appear; and thus, by placing the patient promptly under suitable management, usually but little trouble will be experienced.

**Treatment.**—The treatment, reflecting as it does the previous methods of schools in their advocacy of forced, indiscriminate water-drinking, the exclusive milk diet, and the more or less indiscriminate use of diuretic drugs, is often open to the most emphatic criticism. Every one of these measures is capable of, and has been productive of, no little harm. Too great emphasis has been placed upon forcing the kidneys to act, and too little upon the necessity of relieving them of the work for which they are temporarily incapacitated. The advocacy of drinking large amounts of water when the renal blood-vessels are distended, the tubules are obstructed, and the parenchyma is secreting but very little, does nothing but harm. Under such conditions heart stimulants, such as digitalis, which forces more blood into the kidneys, necessarily make a bad matter worse.

**General Management.**—In treating nephritis there are several factors to be kept in mind. Because a case is mild it should never be given scant attention. Nephritis in a child may be most insidious in its course. The mildest case, while not treated in all respects like a more severe one, should be given every possible attention relating to rest in bed and diet;

for through neglect, even for a very few hours, a mild case may become most severe.

A child with nephritis must be kept in bed with the temperature of the room at about 70° F. He should be protected from drafts of cold air. A mixture of silk and wool or flannel should be worn next to the skin.

*Diet.*—The nutrition of the patient is to be maintained by food which will not add to the existing trouble. We are told that nitrogenous food, such as meat and eggs, is to be avoided in order to relieve the kidneys from the work of excretion of urea and creatinin; and yet often we are advised in the very next line to give a full milk diet, which, in the case of a child from five to ten years of age means from 2½ to 3 quarts daily. Milk, it will be remembered, contains 4 per cent. of nitrogenous food, necessitating that large amounts of nitrogenous waste by-products be excreted by the kidneys.

In order to maintain the nutrition of the patient protein is necessary, and may be supplied by the use of a moderate amount of milk. To a child from five to ten years of age from 16 to 20 ounces of whole milk should be given daily—never more than 20 ounces. This should be diluted with equal parts of cereal gruel, No. 1 or 2, with the addition of 1 teaspoonful of sugar (see formulary, p. 94), and given in amounts of from 6 to 10 ounces at four-hour intervals. The taste of the food may be changed by the use of cereal gruels of different kinds. Zwieback and butter, stale bread and butter, prune-juice, simple fruit jelly, thin apple-sauce, and orange-juice may be given in order to improve the digestion and add variety to the diet. Inasmuch as milk and fruit cannot be taken simultaneously by many patients, the fruit may be given between meals or with plain gruel, and thus increase the nutritive value of the daily ration. Broths and beef extracts are not to be given because of their creatinin content.

*The Salt-free Diet.*—The value of a salt-free diet in nephritis is very generally recognized. The rationale underlying this treatment has been concisely set forth by L. Miller, who, after reviewing the work of Widál, Javal, and other observers, stated the following conclusions:

"In patients with moderately severe nephritis associated with edema the ingestion of large amounts of sodium chlorid is followed by chlorid retention. The patient gains in weight, the edema becomes more marked, the albuminuria increases, and symptoms may develop resembling uremia.

"In patients with very severe nephritis, and especially those with uremia, chlorid retention is very marked, as scarcely any of the extra chlorid administered is eliminated.

"In individuals with apparently healthy kidneys, following the ingestion of sodium chlorid there is a chlorid retention equal to that of a mild nephritis. The individual gains in weight, but there is no visible edema, no albuminuria, and no uremic symptoms."

The degree to which defective kidney excretion is responsible for the edema of nephritis is still in doubt, but it is certain that exclusion of common salt from the food, including even such substances as bread,

is frequently followed by marked improvement, which ceases on a return to the salt-containing diet.

*Bowel Evacuation.*—A patient with nephritis, no matter how mild, should have two bowel evacuations daily. These should be rather loose. The use of the fruit juices may be sufficient to keep the bowels relaxed. If a laxative is necessary, citrate of magnesia, or, for very young children and infants, milk of magnesia, may be given in such doses and at such intervals as may be necessary to produce the desired results. The child should always have an enema at bedtime if no bowel evacuation has taken place during the preceding twenty-four hours.

*Bath.*—A warm sponge-bath should be administered daily, the body of the patient being sponged and dried part by part under a flannel blanket.

*Treatment of Severe Cases.*—When there is fever with partial suppression of the urine, only one-half the usual quantity being passed, and that loaded with albumin, blood, and casts, with perhaps beginning edema, colon flushings (p. 855) with a normal salt solution at a temperature of 110° F. are to be used. The flushings have the effect of increasing the functional activity of the kidneys. In the treatment of a child from five to ten years of age 1 pint of the warm saline solution may be thrown into the colon. An effort should be made to have the child retain the fluid by resting on the left side with the buttocks elevated on a pillow. For young children from 8 to 12 ounces may be used. Infants under nine months may retain only 4 to 6 ounces. The flushings should not be repeated oftener than at twelve-hour intervals, unless the condition is urgent, as intolerance of the parts is readily brought about by too frequent manipulations.

If the skin is hot and dry and the temperature tends to remain above 102° F., tincture of aconite may be given in small doses. To a child three years of age  $\frac{1}{2}$  drop may be given at two-hour intervals. Older children may be given 1 drop at a dose. It is rarely wise to increase the amount above 2 drops at two-hour intervals even for children above ten years of age. Only sufficient aconite should be given to produce a slight diaphoresis, for when the skin is kept constantly moist the blood-vessels of the kidneys are relieved of the tension to which they have been subjected.

In the extremely severe cases, with edema or anasarca, in which but 2 or 3 ounces of urine are passed daily, more active measures will be required. In these urgent cases the diet should consist temporarily of thin gruels of barley, *Granum*, or rice (No. 1), with sugar added to make them more palatable, and diluted fruit juices given between the feedings. In a carbohydrate diet there are no by-products irritating to the kidney. Water should be given scantily, sufficient fluids being given in the food. Active measures to increase diaphoresis and thus relieve the kidneys must be instituted. The best method of doing this is by the use of hot colon flushings, hot packs, hot baths, and hot flaxseed poultices. In these severe cases the use of digitalis and alkaline diuretics does an immense amount of harm. Digitalis drives more blood into the kidneys and thus increases the congestion. The alkaline diuretics disturb the stomach, which is already showing signs of food intolerance. Colon

flushings (p. 857) at 110° F. are to be used every six hours. This is probably one of the most valuable means we possess for relieving the congestion of the kidney and inducing a flow of urine.

*Local Application of Heat.*—Heat, either dry or moist, should be immediately employed in order to stimulate the skin to vigorous action. Dry heat and moist heat each has its advocates. Keeping the child in a warm bath at 105° F. for a few minutes, drying rapidly, and immediately putting him into bed, surrounded by hot-water bottles, will usually produce diaphoresis. A thermometer should be placed under the bed-clothing so that excessive heat may readily be detected, for pronounced weakness is sometimes produced by the use of excessive heat. The child should not be allowed to rest in a temperature higher than 120° F., and heat of this degree should not be maintained over ten minutes. A temperature of 105° or 110° F. may be maintained for an hour if necessary. If the pack is used, it may be repeated once in six hours. The disadvantages of a hot bath are due to the fact that it necessitates considerable handling, which with some patients is a cause of no little excitement. In such cases dry heat may be substituted, the patient being warmly clad in flannels, while hot-water bottles are placed near his body. This may be sufficient to induce perspiration. A device which is readily used consists of a funnel attached to a 1-inch brass pipe, which is bent in the middle to a right angle and which conducts the warm air under the bed-clothing. The heat is generated by a kerosene lamp, over the top of which the inverted funnel is placed at a sufficient distance to allow combustion to take place. The Kilmer croup kettle has an appliance which may be used for this purpose.

In some cases we have had satisfactory results from the use of hot flaxseed poultices made very large, 8 or 10 inches wide and 2 inches thick, and sufficiently long entirely to envelop the abdomen. These are to be applied as hot as can be borne at about twenty-minute intervals for one hour, and repeated again in three hours. This interrupted use of the poultices has been continued as long as nine days, with most marked benefit.

The Murphy drip may also be used, but has not proved very successful. The pressure of the tube in the bowel for the long time required is not borne well by children, and occasions a great deal of restlessness and irritability. We apply this means only in extreme conditions, in which the child's state is such that he is not annoyed.

While a free secretion of urine is desired in these cases, we must not be content with that alone. Uremia may occur even while the normal amount of urine is being passed. A quantitative test for urea should be made in all severe cases in order to determine the amount excreted. Normal urine, in children, contains approximately 2 per cent. of urea, which in health occasionally rises to 3 per cent. Approximately 0.5 gram of urea is excreted per kilogram of body weight. The proportion in children is relatively higher.<sup>1</sup>

<sup>1</sup> R. Bradford, in Allbutt's System of Medicine:

(See continuation of note on opposite page.)

**Treatment of Uremic Convulsions.**—Vomiting is one of the first symptoms of uremia. When it occurs, all food should be temporarily withheld from the stomach and nutrient enemata given. Completely peptonized skimmed milk is our best means of nutrition, from 4 to 12 ounces being given every four to six hours. It is best to give the larger quantity at the longer interval—every six hours is best—as the manipulations with the tube have a tendency to produce intolerance on the part of the gut. The tube should be introduced at least 8 inches into the bowel and the solution used should be lukewarm. Fluid at a temperature of 95° or 100° F. will best be retained. In addition to using colon flushings and external heat in the form of the flaxseed poultices referred to for control of uremic convulsions, one may employ chloroform or the rectal administration of the bromids or chloral. To a child under three years of age 2 grains of chloral may be given with 8 grains of bromid of soda. After the third year 3 grains of chloral may be used with 8 to 15 grains of bromid of soda. This medicine is best retained when given in at least 4 ounces of mucilage of acacia or skimmed milk, the enema being repeated in four to six hours.

When heart stimulants are required, tincture of strophanthus may be given—1 or 2 drops at two-hour intervals to a child under three years of age. After this age 2 or 3 drops may be given. Digitalis is sometimes used as a heart stimulant during convalescence, after the secretion of the urine has been established.

**Convalescence** is often tedious in these cases. The child should not be allowed to be out of bed until albumin has disappeared from the urine. For at least six months after an attack the urine should be examined weekly. Light-weight woollens should be worn next to the skin during the entire year, and every effort made to protect the patient from sudden exposure to the influence of cold air. Upon the advent of any subsequent illness with fever, even though it should not occur for a year or two afterward, unusual precautions should be taken to protect the child, in view of the danger of a reinvolvement of the kidneys, with, possibly, a resulting chronic nephritis. Meat and eggs should be given scantily for a year after an attack. Exercise calling for more than ordinary muscular effort should not be allowed for at least a year after all trace of the nephritis

AMOUNT OF UREA EXCRETED ON THE BASIS OF 0.5 GRAM PER KILOGRAM

		Grams in twenty-four hours.
1 year	Boys 9.29.....	4.645
	Girls 8.24*.....	4.12
3 years	Boys 14.14.....	7.07
	Girls 13.60*.....	6.80
7 years	Boys 22.44.....	11.22
	Girls 21.78*.....	10.89
10 years	Boys 30.22.....	15.11
	Girls 29.07*.....	14.535
13 years	Boys 40.04.....	20.02
	Girls 41.36*.....	20.68
16 years	Boys 56.09.....	28.045
	Girls 51.24*.....	25.62

\* Figures of Boas, quoted from Holt.

has disappeared. It is well to advise, when possible, that the winter after an acute attack be spent in a warm climate, such as that of Florida or Lower California.

### CHRONIC DIFFUSE NEPHRITIS

This disease is rarely seen in children under three years of age, although a considerable number of cases develop every year in children from the fifth to the twelfth year of age.

Nephritis of this type is almost invariably the result of an acute process which has run its course unrecognized, or of faulty management following acute nephritis.

*Illustrative Case.*—A patient who came under observation with chronic nephritis gave a history of having had three distinct acute attacks during the previous four years, with intervals of apparent health. The urine had not been examined during these intervals nor had she had the advantages of proper treatment. Such a history is quite common.

**Pathology.**—In chronic parenchymatous nephritis (chronic diffuse nephritis without marked interstitial changes) the kidney is enlarged, pale, and of decreased consistence. The capsule strips easily, and the cortex, on section, is found to be wider than normal, and frequently of a light yellowish hue. The most pronounced microscopic changes are found in the tubules, the epithelium of which undergoes a variable amount of granular and fatty degeneration and exfoliation. The glomeruli also may show hyaline changes, swelling, and cellular proliferation and desquamation. In some cases the disease is predominantly a chronic glomerular nephritis (see Kidney of Scarlet Fever, p. 495). Interstitial changes are not, as a rule, important. The urine may be cloudy, is usually of increased specific gravity, and contains albumin in variable amount, leukocytes, epithelial cells of renal origin, hyaline and granular casts, and occasionally red corpuscles.

**Symptoms.**—Chronic nephritis rarely develops insidiously as in the adult. Usually it is a continuation of the second, third, or fourth acute exacerbation. Instead of subsiding, the edema and the pallor remain pronounced, and the abnormal urinary findings persist.

Anemia is always present, and, as the condition progresses, digestive disturbances become manifest. The appetite is usually indifferent, and commonly there is vomiting. Other symptoms are marked edema and drowsiness. The progress of the disease is variable. There are periods when recovery seems at hand, and then all the symptoms return in an aggravated form. Ascites is usually present in the advanced cases. Transudation into the pleural cavity and into the pericardium may be looked for. Pulmonary edema is a constant complication a few days or hours before a fatal termination if uremic convulsions are delayed.

**Prognosis.**—The patients are always the subjects of much solicitude. The results have not been brilliant. In some cases the illness began after an infectious disease, usually scarlet fever, and ran a slowly progressive course, which under the best of management defied every effort, terminating fatally in three months to a year. In other cases improvement occurred, casts and albumin disappeared from the urine, and the

child became apparently well. In such cases the ultimate kidney condition can best be determined by the special tests for renal function. (See pp. 828, 829.)

In cases of nephrosis<sup>1</sup> the cholesterol content of the blood shows a marked increase.

*Exacerbation.*—Even in the most favorable cases—as the result of exposure, some intercurrent disease, or some unknown cause—an exacerbation often occurs, and the attack is repeated, usually in graver form than the previous one. The urine becomes scanty and loaded with albumin and casts; the child becomes edematous and pale. Treatment may perhaps relieve the condition, but this attack is followed by another in three to six months, after an interval of apparent health.

*Illustrative Cases.*—In one girl four years old five distinct recurrences took place before death, which occurred in the fifth attack.

A girl nine years old gave a history of chronic nephritis lasting two years. She made a complete recovery—at least there was no recurrence in fourteen succeeding years.

A boy aged four remained well for two years after an illness covering six months. After this period he passed from observation.

*Diagnosis.*—The diagnosis is confirmed by repeated urine examinations. Albumin and casts may be present for a considerable period without other signs than anemia. The anemia, with puffiness about the eyes and swelling of the feet and ankles, is a most suggestive sign.

*Treatment.*—The management of chronic diffuse nephritis of only moderately severe type is to be considered with respect to four factors: diet, baths, exercise, and climate.

If the patient is confined to bed, the diet should be the same as suggested under Acute Nephritis. The food should be largely salt-free. Twenty ounces of milk may be given daily. If the child is up and about, meat may be given once every second day. Eggs should be excluded. In other respects the diet should be simple, as outlined for well children (p. 134), this being ample for nutrition.

The child should receive one warm bath—95° to 100° F.—daily, followed by brisk friction with a dry towel.

An outdoor life is of decided advantage. Exertion, however, should not be allowed to the point of fatigue. Contests or stress of any kind, mental or physical, should not be permitted.

If possible, the child should spend the colder months in a locality which is not subject to sudden or wide variations in temperature. The climate of Florida or Lower California is to be advocated when the parents are financially able to give the patient this benefit. If, however, the patient must be kept in his home, which does not offer the advantages of an equable climate, great care should be exercised in preventing sudden chilling of the skin surface. Woolens should be worn next to the skin at all seasons of the year.

Frequent examinations of the urine should be made for albumin and casts, and such examinations should be supplemented by special tests for renal function (p. 828). Sudden attacks of uremia may occur even while the patient is passing an excessive amount of urine.

<sup>1</sup> Schwartz and Kohn, Amer. Jour. Dis. Child., 24, 2, August, 1922, pp. 125-159.

The management of suppression and anasarca is very much the same as described for these conditions occurring in acute nephritis (p. 497).

Diuretics with which the physician is familiar and in which he has faith, may be given well diluted, so as not to disturb the stomach. In the severe forms of chronic diffuse nephritis we have yet to see a diuretic of the slightest value.

**Edebohls' Operation.**—This relatively rare operation consisting of the removal of the capsule from the kidney for the relief of nephritis has recently been the subject of a review by Morse.<sup>1</sup> This writer arrived at the following conclusions: "Edebohls' operation is of much value in properly selected cases of nephritis in childhood. It may save life and



Fig. 90.—Chronic nephritis before Edebohls' operation.



Fig. 91.—Same case as Fig. 90 after Edebohls' operation.

result in permanent cure in acute nephritis. No child ill with acute nephritis should be allowed to die, therefore, without giving it the advantage of the chance afforded by this operation. It may prolong life for considerable periods in a not inconsiderable number of cases of chronic nephritis, and may possibly, in rare instances, result in cure. It should therefore always be considered in all cases of chronic nephritis in childhood which are not responding reasonably well under medical treatment."

*Illustrative Case.*—A three-year-old girl patient in the Babies' Hospital in the senior author's service presented the typical picture of advanced chronic nephritis (see Fig. 90). The usual treatment with calomel, salines, colonic flushings, and hot packs and diuretics failed to make any impression. The urine presented the usual changes and was very scanty. After two weeks of unavailing treatment, during which period the child became constantly worse, the Edebohls operation of decapsulation of

<sup>1</sup> Jour. Amer. Med. Assoc., lxx, pp. 528-530, August 18, 1917.

the kidney was performed by Dr. William A. Downes, of New York City. The kidney secretion gradually increased—the urine showing but a trace of albumin two weeks after the operation. The thirteenth day following the operation the child had lost 16½ pounds in weight and presented the appearance seen in Fig. 91. There was an interval of two weeks between the time of taking the two photographs.

During convalescence, however, the child developed a very severe colitis, from which she died six weeks after the operation. We look upon this case as a remarkable demonstration of the temporary value, at least, of decapsulation of the kidney. Unfortunately, the intercurrent colitis terminated life before the permanent effects could be determined.

### CHRONIC INTERSTITIAL NEPHRITIS (MALIGNANT HYPERTENSION)

Chronic interstitial nephritis is a very rare condition in children. A typical case was that of a boy ten years of age.

**Etiology.**—The etiology is obscure. In the case referred to no causative factor could be discovered. A persistent toxemia from intestinal sources is the most logical explanation.

Syphilis, alcoholism, and the infectious diseases have all been looked upon by different authors as possible etiologic agencies.

**Symptoms.**—A wide range of symptoms is put down. As our personal experience has been so meager, we can do no better than recite the symptomatology of the only complete case coming under our observation.

*Illustrative Case.*—This boy evidently had suffered from the disease for three or four years. There was a history of chronic polyuria, thirst, and enuresis. He was very small, very thin, and anemic. He was habitually tired and listless. The skin was dry and rough and appeared to be pigmented in spots. There was no suggestion of dropsy, and the child had never been known to perspire. He passed from 60 to 90 ounces of urine daily. The specific gravity was low. The one specimen examined by the writer showed a specific gravity of 1002, no albumin, and no casts. Death resulted from exhaustion and uremia.

High blood-pressure is a prominent feature in such cases.

**Treatment.**—The management of these cases is symptomatic.

### PYELOCYSTITIS (PYELITIS)

Pyelocystitis is an infection of the bladder and pelvis of the kidney. The bladder is probably always invaded, and may be infected before or secondarily to the kidney. Partial ureteral stasis may exist.

**Etiology.**—*Sex.*—The disease occurs with more frequency in girls than in boys. Thompson, of Edinburgh, however, has reported among his cases more males than females. Our own observation is that girls are much more apt to develop the disease, probably in the ratio of at least 5 to 1.

In a report of 3 unusual cases in boys Graves<sup>1</sup> has reviewed facts touching on this selective incidence.

**Age.**—The majority of the patients are under three years of age. Pyelitis may, however, occur at any age. Our youngest patient was three months of age. Pyelitis is comparatively rare after the fifth year. Its occurrence in female adults does not concern us except by reason of the belief of not a few internists that the disease of childhood is carried over to adult life.

**Bacterial and Associated Factors.**—The infection, in the great majority

<sup>1</sup> Amer. Jour. Med. Sci., November, 1917, No. 5, vol. cliv, p. 707.

of cases, is due to the colon bacillus. Any of the pyogenic bacteria, however, which gain entrance to the pelvis of the kidney may cause the disease. Thus the staphylococcus, the streptococcus, the gonococcus, or the typhoid bacillus may be the cause. In one case infection was due to the typhoid bacillus; in another to the staphylococcus. The paratyphoid bacillus was isolated in a recent case at Bellevue Hospital. With the exception of one or two cases the attacks were all either preceded by an acute intestinal disturbance or occurred independently of any illness. Occasionally, as in certain cases of grippe and otitis media, the intestinal disturbance was present, but had been overlooked. The facility with which the infection may take place through the female urethra has been cited as the explanation of the frequency of pyelitis in girls, but the rôle of the lymphatics in conveying bacteria from rectum to bladder, a factor particularly emphasized by Eisendrath and Kahn,<sup>1</sup> must also be considered owing to the closer anatomic relationship of rectum and urethra in the female.

In 2 cases observed by the writer there was a colon bacilluria without demonstrable pus, but with the usual clinical signs of pyogenic infection.

The occurrence of the colon bacillus in the urine of healthy subjects at intervals for shorter or longer periods has been repeatedly demonstrated, the urine in other respects being normal. Probably in many cases of pyelitis developing in association with grip or other febrile infections congestion of the kidney and oliguria contribute to the inflammation of tissue upon which a mild pre-existing bacteriuria has produced no previous lesion.

**Pathology.**—Because of the fact that autopsies performed upon subjects at an early stage of pyelitis have been comparatively rare, the actual nature of the typical lesion produced is not definitely known. Probably, in most instances, the process affecting the kidney is confined to the pelvis in colon bacillus infections. In cases of the same type of long duration, however, the infection may involve the kidney structure causing multiple foci of suppuration, as in the instance below cited. In infections of the kidney due to staphylococcus and streptococcus organisms the lesions are typically cortical from the onset and tend less to involve selectively the pelvis of the organ.

*Illustrative Case.*—In one instance late in the illness pyelonephritis developed which caused the death of the child. The process had extended from the pelvis of the kidney to the parenchyma, which showed dozens of large and small suppurating foci at necropsy.

**Symptoms.**—Pyclocystitis is a disease the chief symptom of which is sudden elevation of temperature. On the other hand, children may have the disease without fever.

With or without some slight intestinal disturbance there is usually a sudden rise in temperature from 102° to 105° F. The rise is usually to the higher point, and is rarely accompanied by a chill. Thomson, of Edinburgh, has expressed the belief that a chill in an infant is always due to a pyelitis. The temperature following the onset ranges between

<sup>1</sup> Amer. Jour. Med. Assoc., lxvi, 561.

101° and 105° F. for three or more days, with remissions to normal. During the temperature period the child is fretful and uncomfortable, but not particularly prostrated. After the fever has passed the patient may appear slightly weak, but is usually bright and manifests no great physical prostration; in fact, may exhibit no sign whatever of illness during the non-febrile period. The disease is often diagnosed as indigestion or some trivial ailment, and is forgotten until there is again a rise in temperature, which runs a high, irregular, or indifferent course for two or more days, and then again subsides. The accompanying chart (Fig. 92) represents an acute case of short duration. In a few instances the duration of an individual attack has been not more than ten or twelve hours.

There is usually no pain in these cases, and no unusual frequency in urination. Very infrequently a case is encountered in which there is bearing down and straining during and after urination. Absence of

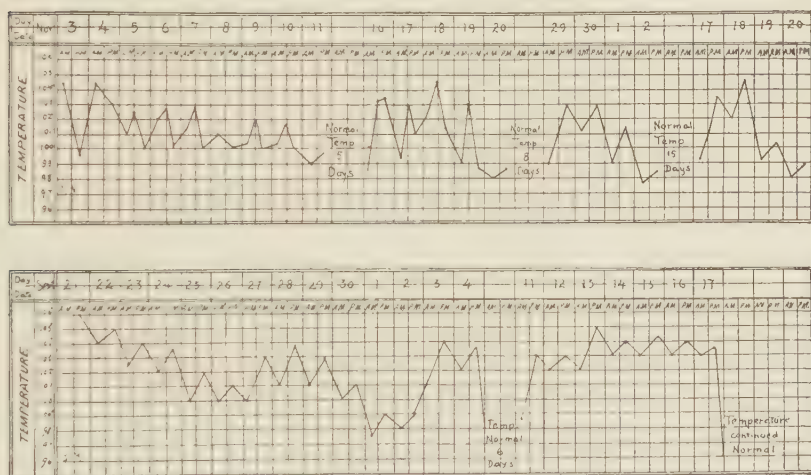


Fig. 92.—Temperature charts—pyelitis.

both discomfort and frequency of urination leads one to believe that cystitis in these cases is probably of a trivial nature.

The symptom above all others of value in this disease is temperature, and when we have unexplained temperature periods in girls, such as are shown in the chart (Fig. 92), pyelitis, upon completing the examination, will almost surely be found as the cause.

**Diagnosis.**—The diagnosis suggested by the fever is verified by the finding of pus in the urine. Pus is not found in every specimen of urine voided. Before deciding that pus is not present in a given case at least three specimens should be secured on different days.

For absolutely accurate work a catheterized specimen of urine should be secured, particularly if the urine is to be cultured. This is not absolutely necessary, however, in routine diagnosis. If the child is carefully washed before urinating and the urine is caught in a sterile vessel, there will not be sufficient contamination to prevent a right conclusion.

**Differential Diagnosis.** The diseases most frequently confused with pyelocystitis are malaria, typhoid fever, and acute intestinal infection. The distinct temperature periods and remissions, with days of normal temperature, effectually exclude both typhoid and malaria. The continuation of the temperature periods, after the intestinal intoxication is relieved, excludes the intestine as the source of the fever. Repeated urine examinations confirm or disprove the presence of pyelitis. In doubtful cases the catheterized specimen of the urine should be cultured, for the possibility of febrile bacilluria without pyuria must be kept in mind. Malformations and calculi call for cystoscopy and x-ray.

**Duration.** The duration is variable, and appears to depend more upon the time the disease has existed unrecognized than upon the nature of the infection.

A patient in whom the condition is discovered early usually responds promptly, and perhaps does not have a second fever period. Others in whom the disease has existed for several weeks undiagnosed may require several months of treatment. It is not at all unusual for a case to continue over two or three months. In one case the disease reappeared after an absence of fever and pyuria for three months. In another case the disease reappeared after six months and in another after eleven months. The continued excretion of pus and colon bacilli over a period of years is not unusual even after the febrile exacerbations have ceased to occur. Whether some of these cases represent a continuation of the old process, or reinfection from the intestine, it is impossible to say. A case should not be pronounced cured under six months, even though there is no return of the fever. The urine, during this time, should be frequently examined for pus. Repeated examinations showing the absence of both pus and bacteria may be taken to indicate a complete cure.

**Treatment.** The readiness with which pyelitis responds to treatment depends considerably upon the duration of the infection. The method of treatment which has proved most satisfactory is as follows: As soon as the diagnosis is positive, from 60 to 90 grains of citrate of sodium are given daily in 10-grain doses at two-hour intervals. Sufficient is given to produce an alkaline reaction in the urine. To maintain the alkalinity the dosage in many instances must be continued through the night, and good results, as Still has emphasized, may be dependent upon careful attention to this point. At the end of ten days the sodium citrate is discontinued and hexamethylenamin given, usually from 16 to 24 grains daily; again at the end of ten days the citrate is resumed. This procedure is repeated, alternating the two drugs until the urine is free from pus. Hexamethylenamin is effective through its liberation of formaldehyd only when the urine is acid. Salol is of doubtful value.

The difficulty that we have experienced has been to obtain sterile urine. The fever is usually readily controlled, but pus and bacteria remain in the urine over long periods.

**Immunization.**—The use of vaccines has not been followed by brilliant results.

The application of this method of treatment to urinary infections in children should, therefore, at present be limited to rare cases of gonococcus or staphylococcus origin, and to the very small group remaining.

which do not respond to medicinal measures. In persistent chronic colon cases vaccine may be given a trial.

Davis<sup>1</sup> has reported cures in resistant cases following the reaction induced by the injection subcutaneously of 20 c.c. or more of whole blood.

## THE BLADDER

### CYSTITIS

Cystitis in boys is very unusual. In girls it occurs frequently. It is not of infrequent occurrence in hospital work.

**Etiology.**—The most common bacteriologic agent in the causation of cystitis is *Bacillus coli communis*; next in order of frequency is *B. proteus*. The presence of these intestinal bacteria is explained by the fact that intestinal disease usually precedes cystitis in children.

Streptococci and staphylococci have been found in the urine in cystitis. Gonorrheal cystitis in children is extremely rare, and tuberculous inflammation of the bladder is uncommon, even in older children.

**Symptoms.**—Frequent calls for urination constitute the most usual symptom; so urgent is the desire to void the urine that the child may be unable to reach in time a suitable place. Incontinence by day and night is usual in children with only a mild degree of bladder involvement. There is, ordinarily, but little pain attending urination. Sometimes there is evidence of distress at the completion of the act, but this is unusual. Inability voluntarily to control the urine during the day, extending over a considerable period of time, points to bladder involvement due either to the presence of stone, which is most unusual, to cystitis, or to a congenitally small bladder.

**Diagnosis.**—Frequent urination due to transient congestion at the neck of the bladder may be confused with cystitis. Such cases, however, are of very temporary duration, and respond readily to treatment, while the urine examination fails to show evidence of bladder infection. Pyelocystitis or pyelitis may be confused with simple cystitis. In cystitis without involvement of the kidneys the fever, which may signalize an infection of the pelvis of the kidney, is lacking. It is almost impossible to say positively when the pelvis becomes involved and when a cystitis becomes a cystopyelitis, for a cystopyelitis may exist for weeks without an elevation of the temperature. In many cases of involvement of the pelvis, however, there probably has been a preceding cystitis. Temperature, when present, is a determining factor in establishing the diagnosis of pyelitis; further, when there is cystitis epithelium from the bladder is often in evidence in the urine.

**Treatment.**—The treatment consists largely in the use of internal medication. Most cases respond promptly. Now and then a chronic case is seen which proves most obstinate.

*Illustrative Case.*—A case of this nature was observed at the Out-patient Service at the Babies' Hospital. The patient, a girl, came with a cystitis well established. Large quantities of pus were present in every specimen of the urine examined. In this case six months' treatment with bladder washings and medication was required before the patient could be considered improved. She then developed poliomyelitis and passed from observation.

<sup>1</sup> Archives of Pediatrics, xl, 10, October, 1923, p. 698.

Irrigation of the bladder may be attempted. It has been of very little service in our hands. Bladder washing is carried on with no little difficulty and annoyance, and usually with unsatisfactory results. The best results have been gained by the use of urotropin and sodium benzoate, 4 to 6 grains of each, three times daily. The frequent urination is thus relieved, and the successive examinations of the urine show a gradual disappearance of the pus.

#### VESICAL CALCULUS (STONE IN THE BLADDER)

Stone in the bladder is rarely seen in children under ten years of age.

The occurrence of suggestive symptoms demands radiography to confirm the clinical diagnosis. Four patients personally observed were boys aged respectively three, four and one-half, five, and seven years. In each case there was cystitis, with frequent and sometimes impeded and painful urination.

The management is entirely surgical.

#### EXSTROPHY OF THE BLADDER

Exstrophy or eversion of the bladder is a rare deformity, affecting, in most instances, the male sex. This condition is due to a defect in the anterior wall of the bladder and to failure of development in the abdominal wall. Through the existing hiatus the posterior portion of the bladder protrudes as a mass covered by reddish mucous membrane, on the surface of which the urine from the ureteral orifices is discharged. Other malformations usually exist, of which the most important are non-union of the pubic bones, absence of the penis or epispadias, absence or non-descent of the testis, and hernia. In the female the embryonic cloaca representing bladder, vagina, and rectum may persist. A determination of the sex of the patient is occasionally difficult.

The condition is most pitiable. The constantly discharging urine makes cleanliness impossible, and the odor of decomposing urine is always present. No means have been devised for a satisfactory collection of the urine. Our own cases have all been seen in hospitals. In these instances abundant cotton in a large pad was bound on the parts and frequently changed. The skin surface round the exstrophy should be protected with zinc oxid ointment, to which 10 per cent. of white wax is added. This applied on linen makes a fairly satisfactory waterproof dressing and prevents the distressing excoriation of the skin.

**Operation.** The operation for deflecting the ureters to the sigmoid or rectum, while rarely successful, should be attempted.

After the ureters are successfully placed, there is always the danger of pyelitis. Cases are recorded, however, in which the results of the operation have been most satisfactory. In one such instance the readiness with which the rectum assumed the bladder function was as surprising as it was gratifying to the patient. The rectum holds the urine from three to six hours without inconvenience.

Various plastic operations have been devised, the object being to secure a bladder orifice to which some portable urinal may be applied.

## THE MALE GENITALS

Practically every male child is born with an adherent prepuce and with more or less constriction at the preputial outlet. The penis is to be considered normal only when the foreskin can easily be retracted, laying bare the glans.

The adhesions and constrictions may be relieved by moderately stretching the foreskin and breaking up the adhesions with a fine blunt probe, after which the glans should be cleansed, oiled, and the foreskin drawn forward over it. The cleansing of the parts with Castile soap and warm water, which necessitates a retraction of the foreskin, should be practised on the uncircumcised at least every second day. This not only keeps the parts clean, but prevents the later formation of adhesions and a possible phimosis.

Circumcision should be performed upon every male child. The operation does away for all time with the necessity of manipulation of the parts. (See p. 512.)

## BALANITIS

Balanitis is a swelling and inflammation of the foreskin due to a local infection. Unskilled manipulation in stretching the prepuce readily produces a laceration, opening up a means of entrance for bacteria. In severe cases the parts first show congestion and then edema. We have seen patients with long foreskins which were twisted and swollen to a size three or four times that of the penis. In advanced cases there will be suppuration beneath the foreskin, with a purulent discharge from the orifice. Examination of the smear from the discharge will show whether or not the case is one of gonorrheal balanitis.

**Treatment.**—If the case is seen early, wrapping the parts in gauze or old linen, which is saturated with an ice-cold solution of bichlorid of mercury 1 : 10,000 and changed every half-hour, will usually be effective. If there is much edema, puncturing in several places, after disinfection, should precede the wet dressing. If there is a purulent discharge, the sac should be gently syringed at least twice daily with a 3 per cent. solution of hydrogen peroxid, diluted one-half with water.

When the suppuration has ceased, with a return to normal of the parts involved, circumcision should be done. Operation during the acute stage, particularly with suppuration present, should be avoided unless the condition is very urgent.

## PHIMOSIS

Phimosis consists of a constriction or narrowing of the preputial orifice, sometimes to a pin-point. In cases where the foreskin is tightly bound to the glans by adhesions the urine may be emitted in drops; in other cases the prepuce "balloons out" during urination and the urine dribbles away. The opening may be sufficiently large to show under pressure the margin of the urethral opening, in which instance urination will be but little interfered with.

Phimosis in addition to causing retention of the urine may be productive of various nervous manifestations, such as restlessness and irri-

tability. In 2 of the writer's cases convulsions were apparently caused by phimosis. Both children had repeated convulsions until they were circumcised. Both suffered from marked phimosis, with retention of smegma and irritation of the prepuce.

**Treatment.**—The cases in which urination is impeded require prompt relief. This can be furnished temporarily by introducing a small probe or a director and carefully slitting the skin with sharp-pointed scissors until the glans is reached. The child should be carefully held by an attendant during the operation and great care should be exercised in introducing the director. After the operation a wet dressing of bichlorid of mercury 1 : 10,000 or a saturated solution of boric acid should be applied to the wound until it is healed.

Circumcision should never be long delayed in cases of phimosis, as it furnishes the only satisfactory means of relief. Stretching is very apt to be followed by recontraction, which only intensifies the original condition, while the unavoidable laceration of the mucous membrane may open a favorable field for infection. Examples are numerous of the harm resulting from force and lack of cleanliness in the management of this simple and easily remedied condition.

#### PARAPHIMOSIS

Paraphimosis is produced by the retraction of a tight foreskin, which later becomes so contracted behind the corona as to prevent the return venous flow. As a result, the glans becomes greatly swollen, deeply congested, and edematous. Urination is impossible. The cases which we have seen have all been produced by the mother or nurse in an attempt to retract a tight foreskin according to the doctor's directions, after he had stretched the prepuce for phimosis.

**Treatment.**—If the retracted skin is edematous, it may be punctured in various places to let out the fluid. Reduction may then be attempted by taking the glans between the thumb and the first and second fingers of the right hand and making gradual pressure backward against the thumb and first finger of the left hand, which grasps the penis behind the prepuce. If the reduction cannot be effected in this way, as occasionally happens if the case is of long standing or the contraction very tight, a longitudinal dorsal incision may be made in the skin at the site of the constriction. After the reduction a wet dressing of a saturated solution of boric acid or of bichlorid of mercury 1 : 10,000 should be kept constantly applied to the parts until the swelling has subsided. Then circumcision should be done.

#### CIRCUMCISION

Should circumcision be practised as a routine measure? There is not the slightest doubt that it would be for the best interest of every male infant if he were circumcised. The operation during the second week of life is a trivial matter. In one out of every five male infants circumcision is a necessity both for comfort and health. In marked degrees of phimosis and balanitis circumcision is the only means of relief.

An important reason for the operation as a routine measure is that

it settles at once and for all time the toilet of the parts. The penis after a proper circumcision requires no further manipulation on the part of the nurse. The daily retraction of the foreskin and bathing of the parts is one of the best means of teaching the child self-abuse. When the parts are not attended to every day or at least every second day, trouble is sure to follow sooner or later, in the form of adhesions and inflammation of the prepuce. The sensations produced by the retraction and the washing are not unpleasant and the child soon learns to produce them himself, through leg rubbing, hand pressure, or other means. (See Masturbation, p. 531.) Time and again, after having stretched the foreskin and broken up the adhesions because operations were refused, the writer has had the patient return in a few weeks with the adhesions and the contractions as bad as before because the nurse or mother, timid or neglectful, had failed to follow directions. In case of phimosis it may require considerable skill to draw the foreskin forward after a retraction. It is not always safe to permit the attendants to attempt it. Not a few times we have seen a paraphimosis (p. 512) which resulted from an inability to bring forward a retracted tight foreskin.

The dorsal slit, so often practised as a substitute for circumcision, is to be used only as a temporary expedient, and as such may be employed whenever circumcision is refused. Never, by any means, does it take the place of circumcision, but invariably leaves a long, redundant flap of skin, which easily becomes irritated, causing no little discomfort and affording the child a great temptation to manipulation.

### UNDESCENDED TESTICLE

During the latter part of fetal life the testicle rests in the scrotum. In a considerable number of infants, moreover, the testicle on one or both sides remains in the canal for a varying period, the descent usually taking place during the first year. When such descent does not occur the condition may be considered abnormal.

In small children usually no inconvenience is caused by the malposition of the organ. We have repeatedly found one or both testicles in the canal up to the sixth year. The testicles may usually be brought down, but disappear as soon as traction is removed. In older boys, after the sixth year, the condition may cause trouble because of the exposed situation, which subjects the organs to possible injury in play. Further, if they are left in the abnormal position, the question of possible faulty development is to be considered.

Permanently undescended testicles in adult life frequently become sarcomatous.

It is important not to confuse undescended testicle with inguinal hernia, hydrocele, or enlarged inguinal glands. On several occasions a truss has been applied to an undescended testicle.

*Illustrative Cases.*—Three unusually fine healthy brothers aged six, eight, and eleven years, respectively, all had retained testicles. In the oldest boy there was an entire absence of one testicle, the other being in the scrotum. In the eight-year-old boy both testicles were firmly fixed in the canal. The younger boy had one testicle in its normal location, while the other testicle could be brought down into the scrotum only by considerable pressure.

**Treatment.**—While boys may arrive at the age of ten years before the permanent descent occurs, waiting is not a wise routine procedure. If the testicle is freely movable and can be brought into the scrotum, nature will cure the condition. When the testicle is fixed and cannot be brought into the scrotum, early operation, at least not later than the sixth year, is advisable. In these cases there is a shortening of the cord, with adhesions, which prevents the descent.

### ORCHITIS

Orchitis is a most unusual disease in the young. It is occasionally seen as a complication of mumps and may also be due to gonorrhea and to trauma. Tuberculous orchitis and syphilitic orchitis occasionally occur, but are exceedingly rare. The disease may be accompanied by hydrocele. When epididymitis is present, it may usually be traced to an injury or to an existing specific urethritis.

**Pathology.**—The inflammation in the epididymis is essentially catarrhal, but may involve the interstitial tissue and extend to the testis. In the latter organ interstitial changes ordinarily predominate.

**Symptoms.**—The process is seldom attended by suppuration, though the inflammation may be so severe as to cause fever and other mild constitutional symptoms. Local manifestations are pain, swelling, increased heat, slight redness, and occasionally some edema of the scrotum.

**Treatment.**—The management entails rest in bed, the use of saline laxatives, if necessary, and support of the inflamed testicles by a wide strip of adhesive plaster extending from thigh to thigh. The application of warm sedative lotions gives much relief from the pain and discomfort, and appears to shorten the duration of the attack. Lead and opium solution, U. S. P., applied on several layers of gauze and covered with cotton-wool, should be renewed every three hours. After the acute symptoms have subsided a suspensory bandage should be worn for several months.

### HYDROCELE

Hydrocele is an excessive accumulation of serum in the peritoneal process enveloping the testicle and epididymis. In children the condition is usually congenital, although it may be unapparent at the time of birth. Hydrocele is also sometimes caused by direct injury.

The affection is commonly described under a classification of the following forms:

(a) *Congenital Hydrocele.*—This exists when the funicular process remains patent, and is frequently accompanied by hernia. The tumor is translucent, elongated, oval, and fluctuating, and is reducible under pressure without special manipulation. When uncomplicated, this swelling, in distinction from one produced by hernia, affords only a dull percussion note and fails to emit a gurgling sound on reduction.

(b) *Infantile Hydrocele.*—This type is distinguished from the foregoing by the fact that the funicular process in the upper portion of the canal is closed. The fluid mass is elongated and irreducible.

(c) *Hydrocele of the Cord (Funicular Hydrocele).*—Simple hydrocele of the cord is occasioned by the closure of the canal in its lower portion,

while the funicular process above remains open. Such a condition is not usual. The hydrocele is separate from the scrotum and may be associated with a hernia.

More frequently the canal is closed at both its upper and lower portions, while the intervening part remains open and is distended by an accumulation of fluid—encysted hydrocele.

(d) *Encysted hydrocele of the cord* is small, translucent, elastic, and irreducible, and may resemble an enlarged lymph-gland or an undescended testicle.

(e) *Hydrocele of the Tunica Vaginalis, with Normal Obliteration of the Funicular Process*.—"Common vaginal hydrocele" is firm, tense, fluctuating, and irreducible. Above the upper limit of the swelling the cord may be distinctly felt.

**Treatment.**—The cure of hydrocele in infants is usually spontaneous. When the hydrocele is exceedingly large aspiration of the fluid under rigid aseptic precautions may produce a permanent good result. In cases of the congenital variety, especially those associated with hernia, the wearing of a truss is important as a means of assisting in the obliteration of the funicular process. Injections of irritants have not been

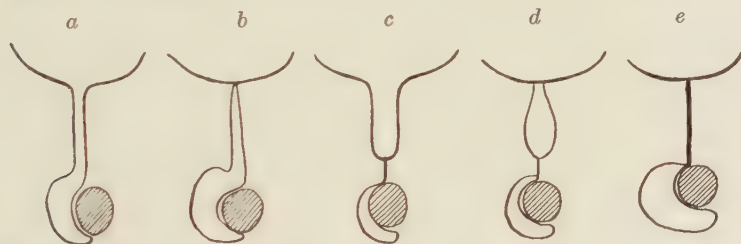


Fig. 93.—Varieties of hydrocele: a, Congenital; b, infantile; c, funicular; d, encysted; e, vaginal. (DaCosta's Modern Surgery.)

necessary in our cases. Such a procedure is rarely to be advised. Much harm may be done by punctures and injections into the sac. Severe cases of infection of the parts have resulted from such procedures.

If the condition persists a radical operation for the cure of hydrocele may eventually be performed.

## GONORRHEA IN THE MALE

Specific urethritis in male infants and male runabout children is of rare occurrence. Eight patients under five years of age have come under the writer's observation.

The oldest of the group, aged four years, developed a stricture. The boy's home was in a tenement and he had been repeatedly exposed through another member of the family, who hoped to rid herself of the trouble by giving it to the boy.

The other cases occurred in a children's institution in which there was an epidemic of specific vaginitis.

**Treatment.**—The younger boys appear to respond unusually well to an irrigation of 8 ounces of a 1 : 10,000 permanganate of potash solution used twice daily. This may be supplemented by argyrol or protargol injections, carefully instilled into the urethra by the physician.

## EPISPADIAS AND HYOSPADIAS

Both of these abnormalities are congenital defects in the development of the penis, characterized by imperfect closure of the urethral groove.

In most cases of *hypospadias* the urethra terminates before reaching the base of the glans. In *epispadias*, which is much less common and frequently accompanies exstrophy of the bladder, the urethra opens upon the dorsum of the penis.

The simpler forms of hypospadias may not require treatment, particularly if the urethral opening is within an inch of the normal position of the meatus (Wyeth). When, however, the malformations cause imperative demands, plastic surgery should be attempted.

## THE FEMALE GENITALS

## PRECOCIOUS MENSTRUATION AND PRECOCIOUS MATURITY

Precocious menstruation is a physiologic anomaly of development (Morse). The usual time for menstruation to begin is between the ages of twelve and fifteen years. In some races catemenia begins normally as early as nine or ten years.

There are two distinct types of cases. In one group the precocious menstruation is the only symptom, while in the other there is precocious maturity, the early menstruation being accompanied by the anatomic changes of puberty.

The menstruation in children of the former type usually begins earlier than in those with precocious development. The average age is five years, but there have been instances reported in which hemorrhages begin at birth. The periods last from one to three days and may be regular throughout childhood. This is not usual, however, for at times for a year or more there may be no signs of menstrual flow. The physical and mental development of these children is perfectly normal.

*Illustrative Case.*—A private patient, strong and robust, began to menstruate at the twenty-first month; the intervals were very irregular at first, ranging from a few weeks to two or three months, but with a fair degree of regularity during the period from three to nine years. Pubic hair developed at the sixth year and the breasts began to develop at the same time. To all outward appearance at nine years she was a perfectly normal child, with no other signs of early sexual development.

In the second group we are dealing with a profound disturbance of development probably due to some derangement of the ductless glands. Lenz, in a most exhaustive review in 1912, was able to collect only 150 such cases from the literature. Menstruation in these children usually begins early, that is, during the first two years and frequently at birth. In 51 cases collected by Morse, 36 began during the first two years. These patients are usually large at birth. They have large breasts, axillary and pubic hair, and a prominent mons veneris. They develop very rapidly and at eight or ten years may present the full maturity of the adult. The menstruation is regular and preceded early in life by various feelings of discomfort, analogous to those which announce the periods in women. There is also an early development of bone as shown by *x-ray*.

That the menstruation in these children is accompanied by ovula-

tion has been proved by autopsy, and there are cases in the literature in which pregnancy has developed in childhood. One patient began to menstruate at two years, became pregnant at eight years, ceased to flow at twenty-five years, and lived to be seventy-five without a recurrence.

The *etiology* of this condition is obscure but there are facts which seem to indicate that it is due to a disturbance of the endocrine glands. There have been instances in which the abnormal development is reported to have ceased and even retrogressed after the removal of cystic tumors of the ovary. (Cf. p. 480.)

These children should be kept apart from other children. Their early modesty sense should be respected.

### SIMPLE VULVOVAGINITIS

In simple vulvovaginitis there is an inflammation of the mucous membrane of the external genitals, with a slight involvement of the vagina in its lower portion. Further extension of a non-gonorrheal infection to the uterus and tubes probably never occurs.

The orifice of the urethra is usually reddened and inflamed.

**Etiology.**—Ill-conditioned children, and those improperly cared for, furnish the majority of the cases. Now and then an apparently healthy girl will develop the disease.

Irritation from hand manipulation in masturbation, scratching in eczema, thread-worms, and constipation may all bring about the discharge. The ailment is particularly common in anemic girls whose vitality is habitually below normal.

**Symptoms.**—There is moderate itching and burning of the parts and a secretion of rather viscid mucus. In some cases there is a yellow, purulent discharge, resembling that of gonorrheal infection. The attention may be first called to the condition because of a staining of the clothing.

**Diagnosis.**—The condition in which there is a purulent discharge requires to be differentiated from gonorrheal vaginitis. This is very readily done through bacteriologic examination. Without the aid of the microscope differentiation is impossible.

**Prognosis.**—The prognosis is favorable. Most cases recover in a few weeks. Resistance to treatment and chronicity point to the presence of the gonococcus.

**Treatment.**—The management comprises both constitutional and local measures. The patient should be given a daily living régime with directions as to when she shall rise in the morning, when she must retire, and the amount of rest she must take in the middle of the day. In this way the output of energy is curtailed and waste is prevented. The diet should be so arranged as to give the patient the most nutrition with the least amount of digestive activity. Bitter tonics, cod-liver oil, and iron are to be given when indicated. As much out-of-door life as is possible should be encouraged. In short, the measures advocated in the section on the Subnormal Child (p. 140) are applicable here.

**Local Measures.**—Bathing the genitals twice a day with warm water

and Castile soap, followed by drying with absorbent cotton, prepares the parts for an absorbent dusting-powder, which has proved useful in these cases. The powder is of the following composition:

Acidi borici. . . . .	gr. xxv
Pulveris amyli,	
Pulveris zinci oxidi. . . . .	āā ʒss

The more nearly dry the inflamed surfaces are kept, the more prompt will be the relief. If there is a tendency to a free secretion of mucus, the powder may be applied at intervals of two hours.

A convenient means of applying the powder is with an insufflator, which may be obtained from any apothecary. After the parts are packed with the powder, a dressing of old linen should be applied and held in position by a napkin binder. The powder should be reapplied often enough to keep the parts dry.

Many cases of long standing respond promptly to the above management.

#### GONORRHEAL VULVOVAGINITIS (SPECIFIC VAGINITIS)

Vaginitis of this type is very prevalent among the congested tenement population in all large cities. Institutions for children, if they would admit the patients, could always supply a considerable number of cases.

**Etiology.**—It is almost impossible to keep the infection out of institutions, and when it once enters, it is most difficult to remove. The disease is quite distinct from venereal disease in the adult, in that it is contracted through indirect means. The hands of the mother or nurse, towels, napkins, the thermometer, may all furnish a means for transmission from the infected to the healthy. Day nurseries, most necessary institutions, are often unwittingly distributing agents of the gonococcus.

In private work we have known of several cases in which the mother had a vaginal discharge of a suspicious character. In 2 cases only the disease was evidently contracted from a nursery maid.

**Age.**—No age is exempt. Very young females—under three years of age—furnish most of the cases. The infection is not infrequent in newborn infants. In older girls, after the tenth year, the possibility of infection through sexual contact may be considered, but at this age the disease is most unusual; in fact, very few cases are seen in children after the eighth year.

A resistance to the indirect transmission of the infection appears to be acquired with advancing years. The nursery maids in training will live for months in an infected ward, working with the patients, and not become infected, whereas if a healthy female infant is placed at any point in the room, she may become infected in twelve to thirty-six hours.

A female child six months of age, admitted into a ward maintained with care and cleanliness, containing 12 healthy females of about the same age, may transmit the disease to one-half of the number in two or three days.

**Symptoms.**—Redness of the vulva may be apparent without discharge, or there may be a mucous, mucopurulent, or purulent discharge.

The typical discharge is thick, viscid, and of a greenish-yellow color. If the case is of considerable duration, there will be redness and excoriation of both mucous and skin surfaces. There is a good deal of itching and discomfort. In older children micturition may be painful. In infants no discomfort whatsoever appears to be occasioned by the disease.

Extension of the infection through the uterus to the tubes and pelvic cavity is of most unusual occurrence. Hundreds of these cases may be observed without exemplifying a complication of this nature. The inflammation very rarely extends beyond the cervix. An endocervicitis, however, is usually present.

**Diagnosis.**—The presence of a vulvovaginal inflammation with or without discharge suggests the possibility of a specific vaginitis. It is a mistake to suppose that there must be a visible discharge in each case. Time and again smears taken from a vagina that is simply moist will show the gonococcus.

Microscopic examination of the secretion must decide whether or not the case is of gonorrheal origin.

**Prognosis.**—A guarded prognosis must always be given. Under the care of a trained nurse and intelligent mother we have seen cases recover in three weeks, but usually from four to eight weeks are required, and then management such as is suggested below must be followed out most thoroughly. Moreover, apparent recoveries are frequently incomplete and are succeeded by relapses. Vaginitis among female patients in an institution is much more difficult to cure.

**Complications.**—The most frequent complications are conjunctivitis and arthritis. Conjunctivitis is the one most commonly encountered. Arthritis (p. 794) is not at all unusual.

**Prophylaxis.**—This disease is one of the most infectious of all infectious diseases. In order to prevent its spread in a family in which there are two or more girls, or in an institution, it is necessary not only to prevent personal contact, but also to prevent any association of any nature whatever, and this includes attendants, clothing, feeding and cooking utensils, and thermometers.

It seems almost impossible for nurses in attendance in vaginitis cases not to convey the disease to well female infants. At the New York Nursery and Child's Hospital it was found necessary to put the infected children in a separate building, with nurses who cared for them only. Cheese-cloth napkins were used, then burned. All other clothing and bed-linen was boiled before being taken to the general laundry.

**Treatment.**—The course of the disease is most protracted, and there is no specific medication which we may use either locally or internally. The writer has treated hundreds of these cases in many different ways, including the use of solutions of bichlorid of mercury and of permanganate of potash of different strengths. Various silver salts in different strengths as applications to the parts have likewise been employed. Such experience has demonstrated that keeping the parts clean through douching does more toward terminating the disease than does the use of any particular disinfectant wash or application. Douching of the parts is to be practised four times daily, if possible, with the use of 2 quarts of water. It is useless to attempt the treatment of a case without pro-

vision for douching at least twice a day. It may be remarked that this is a very trying treatment for both patient and nurse. Such is certainly the case, but we are dealing with a disease in which only strenuous measures give hope of cure.

*Details of Procedure.*—In order to receive the douche most effectively the child should be placed on the back on a douche-pan. A glass female catheter attached to a fountain-syringe is all the apparatus required. The catheter is passed about  $\frac{1}{2}$  inch within the vaginal orifice, and the water allowed to run. The lower end of the bag should not hang higher than 2 feet above the child's body. Boric acid is a safe drug in any household, and for this reason is usually selected instead of bichlorid of mercury, permanganate of potash, or any other antiseptic. We are not at all sure that plain boiled water would not answer just as well. It would be difficult, however, to persuade many families to use the repeated douching without the addition of some antiseptic to the water. Accordingly, the mother or nurse is instructed how to prepare 2 quarts of a saturated solution of boric acid. This is used as a cleansing agent. After the parts are dried with sterile absorbent cotton a dusting-powder of the formula given on page 518 is freely dusted into the vagina and over the diseased surface not only after the douche but also at two-hour intervals, during the time the child is awake, from early morning until late at night. It is best to tell the attendants to *pad* the parts with the powder. Over this is placed absorbent cotton or gauze, which is covered with the napkin. The attendants should be warned of the danger of infecting themselves and other children in the household with towels, sponges, etc.; in fact, sponges should never be used in these cases. The danger of infecting the eyes, not only of the patient, but of the attendants and others who may come in contact with the case, should be carefully explained. When washing or drying is necessary, absorbent cotton or old linen should be used and immediately burned. Cheese-cloth napkins should be used and burned as soon as soiled. A child suffering from gonorrheal vaginitis should sleep alone.

A patient treated as above may recover in three weeks, though usually from four to eight weeks are required, and in some cases the treatment must be continued for months. In many obstinate cases the direct application of antiseptic solutions to the cervical canal by the aid of the endoscope will complete the cure. For this purpose 10 per cent. silver nitrate or Lugol's solution of iodin may be used. After we have arrived at a point where we consider the case cured, there will sometimes be a renewal of the discharge. The treatment must then be resumed.

Before the case is finally discharged at least two bacteriologic examinations of the vaginal secretion should be made in order to determine positively the absence of the gonococcus.

What becomes of the many cases in which the treatment is not continued or the cases that are never treated? We are confident, from the large number of infant females who have the disease and its absence in older children after the fourth year, that cure often takes place spontaneously, without after-results. The gonococci become fewer in number and eventually disappear.

*Vaccine Treatment.*—Treatment of the disease with vaccines offers

no better results—probably not as good results as are obtained by local cleanliness and the above treatment.

#### ATRESIA OF THE URETHRA AND VAGINA

**Atresia of the Urethra.** This is a congenital occlusion or stricture of the urethra, due to agglutination of the walls or closure of the meatus urethræ by membrane. The obstruction is often incomplete.

*Treatment.*—In some instances simple incision at the meatus may relieve the condition. Extreme cases will require urethrotomy, combined, perhaps, with forcible catheterization.

**Atresia of the vagina** may be due to imperforate hymen (atresia hymenalis) or to the presence of a transverse septum obstructing the passage at a higher level. A rectovaginal fistula may coexist with the atresia. Atresia of the vagina has been recognized as a cause of hematocolpos, hematometra, and hematosalpinx. The possible existence of this malformation should be considered in all cases of delayed menstruation.

The *treatment* is surgical.

## XVI. AFFECTIONS OF THE NERVOUS SYSTEM

### HEADACHE

A COMPLAINT of headache, particularly repeated headache, on the part of a child should always be respected. Its occurrence is of greater import than in the adult.

In children of any age headache may be an early symptom of meningitis, particularly of the tuberculous form, in which the headache may exist for days without other signs of illness. In eye-strain headache is a very prominent symptom, and may be the only evidence that an ocular defect exists. In cases of persistent headache that cannot otherwise be satisfactorily explained the physician should invariably have the eyes examined. Headache is often the earliest sign of acute infectious disease; it is a premonitory symptom of scarlet fever, measles, or pneumonia, and is frequently the only discomfort complained of by a child who has acute tonsillitis. Persistent toxemia from any source may be a cause of headache. Such toxemia may occur in nephritis and in malaria. The most usual source, however, is the intestinal tract. With persistent toxemia of intestinal origin anemia is generally associated. This condition may exist without constipation. Fatigue, as a result of overwork at school, or hard play and unusual excitement, may be a cause of headache in neurotic children. Late in the school year it is frequently encountered in girls. Examination of the urine may show marked indicanuria. Children are imitators of adults, and in a family with the headache habit the child may complain when the condition does not exist. Such simulation may readily be interpreted.

**Treatment.**—The management of headache consists in the discovery and removal of the cause. An ice-bag or an ice-cloth applied to the head affords much relief in the acute febrile cases. Ocular defects should have the benefit of rest and suitable glasses prescribed by an oculist. Fatigue headaches are best controlled by limiting the amount of work and providing long periods of rest. Headaches due to intestinal toxemia with the usual accompaniment of anemia are often most difficult to relieve. In spite of our best efforts, the intestinal digestion may remain faulty for a considerable time. A change of residence and a radical change in the habits of life are usually the best means of effecting a cure. The management of these cases is considered in detail under Persistent Intestinal Indigestion (pp. 231, 232).

### PAVOR DIURNUS

Day-terrors are of occasional occurrence. The writer's cases have all been due to intestinal toxemia in children who showed very poor milk capacity. The fright has never been as severe as that occurring at night.

*Illustrative Cases.*—A boy, two and one-half years of age, asked his nurse to brush the bugs off his lap-robe and clothes. When the nurse failed to discover the bugs, the boy attempted to brush them off himself. When asked what kind of bugs they were, he repeated "all kinds."

A case almost identical with the foregoing was that of another boy three years of age.

A girl four years of age would suddenly stop her play and hold conversation with imaginary people or objects and maintain that the people were present, and describe their appearance and dress. As suddenly she would return to play. At these times it was with difficulty that the child could be brought to her normal condition of mind.

In all these cases there was chronic intestinal indigestion manifested by heavily coated tongue and foul breath. The children recovered entirely upon relief of the intestinal condition.

Uncontrollable attacks of screaming in young children have been attributed to pavor.

### NIGHT-TERRORS (PAVOR NOCTURNUS)

The child with night terrors is aroused from his sleep, thoroughly frightened, imagining that animals or persons are trying to injure him. He begs to be protected. The following morning he has no recollection of the occurrence, and is rather amused than annoyed at the episode.

**Etiology.**—In a great majority of the cases the trouble is due to a deranged digestion in a neurotic child. This, however, is not necessarily the case. We have repeatedly known apparently healthy children to have the attacks. In a recent case the terrors were due to excessive fatigue.

*Illustrative Case.*—The boy, four years old, had been treated elsewhere and had received careful medication and diet. The attacks continued nearly every night for a year. The mother stated that her own health and the boy's were badly affected because of the broken night's rest, and she looked upon the condition as very serious. Upon learning every detail of the boy's life the writer discovered that there was an older and very active brother of six years with whom the patient played daily, and who acted as a pacemaker for the patient. The older boy was sent from home, and a quiet, uneventful life was prescribed for the younger boy. There was no change in diet, as this was not necessary. For one week 8 grains of bromid of soda was given at bedtime to break the habit. During the next ten days there were two mild attacks. After this the boy slept throughout the night, with no relapse for eighteen months.

Such cases as the foregoing are unusual. Indulgences in unusual articles of diet cause many attacks which may be compared to night-mare in the adult. When repeated attacks occur, it will usually be found that the child is suffering from persistent intestinal indigestion, or that the evening meal is, as a rule, beyond the patient's digestive capacity.

*Illustrative Case.*—A boy patient who was four years of age when he came under observation had, during the next five years, two attacks of night-terrors each year. One attack occurred on the night of his birthday and the other on Christmas night. At those times, in spite of repeated warnings and the repeated attacks, he was indulged in unsuitable articles of food.

Overwork at school and anxiety regarding school duties and lessons have been factors contributing to night-terrors. Contributing factors also are adenoids, enlarged tonsils, and worms.

**Treatment.**—If the patient is a school child and the case is aggra-

vated, school should be temporarily discontinued and all exciting play and books of an exciting nature forbidden. The heaviest meal should be taken at midday. The evening meal should consist of cereals, milk, stale bread and butter, and stewed fruits. The child should never be allowed to go to bed unless an evacuation of the bowels has taken place during the previous twenty-four hours.

In the very nervous and irritable cases from 5 to 10 grains of sodium bromid may be given at bedtime. This should not be continued longer than a week. If the child is delicate, anemic, or suffering from adenoids, enlarged tonsils, or thread-worms, these conditions, any one of which may contribute to night-terrors, should receive proper treatment.

### GYROSPASM (SPASMUS NUTANS)

Gyrosptasm is a functional nervous affection usually seen in children under one year of age who lack sufficient sunlight.

**Etiology.**—A considerable number of these patients have come under our observation, and all have been children suffering from malnutrition. Rachitis is usually present. Two of the patients were mentally defective.

**Symptoms.**—The disorder consists of a rhythmic rotatory movement of the head, at times from 20 to 40 oscillations being made in a minute. The movement may be not only lateral, but vertical, which constitutes what is known as head-nodding. In one of our patients both the lateral and vertical movements took place.

The oscillations are usually, but not invariably, associated with nystagmus. The movements of the head occur only when the child is erect, and the oscillations with the nystagmus are increased when the child's attention is focused on some object.

**Prognosis.**—The prognosis is good if the child is mentally normal. None of these children die of this disease, and practically no cases are seen after the eighteenth month. With improvement in the physical condition and development of the nervous system, the motions cease and occur only under excitement. The disorder is essentially chronic, and the improvement is slow. The mother becomes dissatisfied with the treatment, and wanders from clinic to clinic. This explains in part the large number of cases seen by pediatricists.

**Treatment.**—The only treatment of value is along nutritional lines. We have had the opportunity to give a few cases a fair trial with sodium bromid in doses from 12 to 18 grains daily, a treatment which is generally advocated for this condition, but have failed to note any special benefit from the method. With an increase in age and improvement in nutrition the patients whom we have been able to follow have slowly improved and recovered. Sunlight and cod-liver oil treatment are particularly indicated.

### HYSTERIA

Hysteria is a functional disorder, rare in young children, and characterized by nervous crises.

Our youngest patient was three and a half years old when first seen, but the hysteric manifestation had been present for several months.

Mental, motor, or sensory manifestations may predominate in an individual case, although in all cases the condition is associated more or less directly with an absence of mental control. Girls are more frequently affected than boys, but some of the most typical cases coming under our observation have been among the latter.

**Etiology.**—We are taught by neurologists that hysteria is almost invariably of hereditary origin because of its apparent direct transmission from parent to child. It must be remembered that the child, in addition to being born of a hysteric mother, is in constant association with her. Actually, in hysteria we have exemplified in the most perfect degree the effect of environment. A neurotic, hysteric mother puts the whole family in a state of high nervous tension. We know of several such instances. A neurotic, irritable father will make the whole family neurotic. We know of such instances also. Fortunately for the offspring, both conditions are seldom combined in one family. When they are, the future of the children is discouraging. When one of the parents is sufficiently normal to offset a reasonable degree of neurosis on the part of the other, a stable equilibrium may be maintained.

*Imitation* is one of the strongest characteristics of the growing child. How often, when arranging with the mother a diet-list for one of these nervous, ill-conditioned children, have we heard the child say that he "hated" cereals, or "hated" vegetables, or "hated" eggs or fowl; or that he "adored" some other articles of food; this adoration and hatred, particularly the latter, often influencing the entire future of the child; for without a properly regulated diet for every day in the year only an inferior type of adult can be the outcome. In such cases it will usually be found that the likes and dislikes of the child are identical with those of the parents, whose preference has often been expressed in the presence of the child. "Heredity" here furnishes to the parents a satisfactory explanation of the child's limitations in diet. It will usually be found that parents who live normally have children who eat normally.

Illnesses and ailments of different kinds should not be discussed before nervous and impressionable children. Time and again an investigation of a peculiar pain in a child's head, side, or back which cannot be accounted for by the physical examination will be explained by a similar pain in some older member of the family.

**Illustrative Cases.**—In one family the senior author has seen three generations of genuine hysteria. In the first generation the father, chronically irritable and neurotic, was a business man with large interests, rarely ceasing, when at home, to talk about his ailments and their remedies; and the mother had marked hysteria, indulging in frequent attacks, with apparent unconsciousness lasting for hours. The daughter, brought up in this atmosphere, through heredity and environment soon became markedly hysteric. When some dispute arose in the family (which was not an infrequent occurrence) both she and the mother would have simultaneous attacks of hysteria. In due time the daughter married and gave birth to a daughter, who promised to maintain the family traditions, with certain additions of her own.

A girl seven years of age lived in deadly fear of appendicitis and developed an attack of hysteria every time she had a pain. She could locate "McBurney's point," and knew the various stages in the development of the disease and the steps in the operation for appendicitis. The mother's appendix, suitably preserved, is among the family relics, whence it cannot be removed. The influence of heredity perhaps had the effect of making the child alert, precocious, and impressionable. Such favorable soil and the constant association with the hysteric will almost surely develop hysteria in a child.

**Symptoms.**—Three forms of hysteria may be seen—the mental, motor, and sensory types. An individual may show one, two, or all of the types.

Hysteric patients will be found who have indulged in “tantrums” from very early life. They enjoy their seizures, which are usually manifested by laughing and crying violently in alternation; and not only do they enjoy the indulgence in an attack, but the attention they receive. They are usually obstinate, and do not attempt to exert what mental control they may possess. They may become most violent. Upon attempting to quiet a strong girl of ten years in a violent seizure of hysteric mania the writer came out a victor, but required the use of plaster bandages as well as the service of a tailor before he could continue the work of the day.

*Illustrative Case.—The Motor Type.*—A girl thirteen years of age had not been able to walk for three weeks; she was most calm and collected. Examination showed her muscle and nerve condition to be normal. There was no hyperesthesia nor anesthesia, and the muscles of the legs and back were entirely under her control when she was in bed. As soon as she attempted to walk the legs gave way and she sank to the floor. About one year earlier she had passed through a period when the left arm could not be used for three weeks. She was very fond of looking out of the window. She soon could walk in the direction of the window, but would fail utterly when walking in any other direction. Likewise she could stand by the window and in front of the mirror—she was decidedly handsome—but in other situations the legs would not support the body.

The *convulsive cases* exhibit every variety of contortion. The patients throw themselves about in apparent unconsciousness, without regard, yet it will be remarked that they always manage to fall in a soft place. Hysteric patients never injure themselves to any extent. If they pull their hair, they do not pull very hard. They pull another person's hair much harder than their own.

*Illustrative Case.*—A girl of eleven upon little or no provocation would pass into a trance-like state and remain in this condition for five or six hours until she became very hungry or thirsty. During the attack it was impossible to arouse her by any ordinary means. On one occasion “Fire! Fire!” was cried in an adjoining room. This promptly brought her to her feet. Later attempts along this line were without effect. When, however, instructions were given that no attention be paid to her when in the attack the hysteria ceased to be interesting to her and terminated.

*Globus hystericus*, hiccup, and inability to speak have all been encountered from time to time.

*Illustrative Case.*—A girl of eight developed an incessant cough, which drove the members of the family to distraction, but was easily controlled through suggestion.

That imitation is a factor of much importance is shown by the dancing mania of former days, and more recently by the school epidemics, necessitating the closing of the school.

*Illustrative Case.*—In a country school a new girl had habit chorea. Two of the larger boys amused themselves imitating her. Other small boys and girls imitated the boys, and soon the whole group of 30 children were grimacing to such an extent that a temporary closure of the school was necessary.

*Hyperesthesia and anesthesia* are not common.

*The Sensory Type.*—This manifestation in children is also quite unusual. Hysteric anorexia or hysteric vomiting has occurred in a few

instances. In hysteric anorexia the patient may be unable to eat in the presence of a certain person, or exhibit inability to eat in a certain room or locality, or be able to eat only with certain utensils or in a favorite room or locality, or with the body in a special position.

*Illustrative Case.*—A girl three years of age was brought for treatment because she vomited at the table, over the table, and over any one who was sufficiently near. Not every meal was lost, and food given between meals was retained. There was sufficient disturbance of nutrition to warrant anxiety on the part of the mother. The child was pale, thin, and undersized, showing a moderate secondary anemia. From infancy there had been some gastro-intestinal disturbance, and the child had been the source of much anxiety to the mother in this regard. For about a year the vomiting at the table had been very distressing. The child had been treated in various ways for stomach disorder or disease, without any improvement whatsoever. After a thorough examination and review of the case the diagnosis of hysteria was made and it was directed that the mother, who had neurotic tendencies, should keep apart from the child as much as possible. The child was now not allowed to dine with the mother, but was permitted to dine in the kitchen with the maid of all work. The vomiting stopped at once. After about ten days of dining in the kitchen, during which the patient showed marked physical improvement, the maid was called away on account of illness; the child returned to the family table, and again promptly vomited once or twice a day at about the completion of the meal. In three days the maid returned and the child took up dining in the kitchen, with the former satisfactory results. This continued for a few weeks; then there was a disagreement between mistress and maid, and the maid left, never to return. Again the child was placed at the family table, and again the vomiting recurred. Whether the child ate with the family or dined alone, the presence of the mother was sufficient to produce the vomiting. Accordingly, after many terrible trials and many failures, the mother, thoroughly distracted, placed the child in the family of nearby relations, where there were no other children. Here she retained her food and thrived.

We have treated other vomiting cases of similar nature, but none so obstinate.

**Diagnosis.**—The diagnosis of hysteria is made chiefly by exclusion of symptoms referable to organic disease of any nature. Electric tests and other forms of examination will establish the non-pathologic character of the illness.

**Duration.**—There is a marked tendency to relapse. Patients who continue to live under the original neuropathic environment usually continue to enjoy their hysteria. Duration and prognosis depend upon the opportunity for right management and co-operation on the part of the family and friends.

**Treatment.**—*General.*—Our results with hysteric children have usually been very good or very poor, depending to a great extent upon ability to separate the child from the family. By this statement the proper management of hysteric children is indicated.

The child should, if possible, be removed from the unfavorable family influence. The boarding-school has effectually cured several of the writer's cases. Here the child is placed under the care of trained teachers, who bring out the good and correct the bad by reason, precept, and example, and thus exert a continuous beneficial influence. In the boarding-school, plain diet, pleasant occupation, agreeable association, and a scientifically regulated life replace the spoiling and coddling, and often the unsuitable food, together with the endless nagging which the neurotic mother is very apt to indulge in, with the best intentions, of course, but nevertheless with a most unfortunate effect upon the child. If the child is too young for a boarding-school, or if admission is denied him, he should be placed under the care of some kindly, well-balanced woman as com-

panion and instructor, and see as little of his family as possible; otherwise but little can be expected from the treatment. Of course, the conditions must be explained fully to the parents, in order that they may make an effort to regulate their bearing toward the child in the right direction. If the former intimate associations with the child continue, the good intentions may prove effective only a very few days. It is impossible to reform the habits of life of a neurotic adult. Once hysteric always hysteric does not come far from the truth. The only hope for the child is in his complete removal from such unfavorable influences.

*Physical and Mental Activity.*—The further treatment of hysteric children consists in curtailing the mental and physical activities, which almost invariably have been excessive. A rational scheme of living should be formulated. "Showing off" the child to visitors and others should be forbidden. If the patient is under ten years of age, he should retire at 7 o'clock every night, and rise at 7 every morning. It is to be understood by the attendant that this does not mean 6.45 or 7.15. Every day after the midday feeding the child should rest quietly in a darkened room for an hour or two. Whether he sleeps or not, he should rest in a recumbent position with clothing removed. For such children exciting games of stress and competition of every nature are forbidden. An outdoor life is to be encouraged. A bicycle, a pony, an individual play-room in winter, and a tent on the lawn in summer, should be provided when possible. School instruction may be given, but the child is not to be crowded. The amount of study and school work depends, of course, upon the child's condition. Until the tenth year, however, there should be but one session (and that in the morning) of one and one-half to three hours. The child should be given a tub-bath or brine bath daily at 90° F. (p. 843). At the completion of the bath he should stand with his feet in warm water and be given a cool douche at 70° to 60° F., the spray tube being attached to a faucet. Cold water may be poured down the spine. This application of cold water should be for a few seconds only and should be followed by brisk rubbing with a rough towel, which should result in a decided skin reaction.

*Treatment During Hysteric Seizure.*—During a hysteric seizure the child should be treated with kindness, but with firmness. No sympathy should be shown. The application of ice-water to the face and chest is usually sufficient to break up an attack. In some cases a certain amount of time appears to be required for a return to the normal.

*Drugs.*—Sedative drugs, such as the bromids, should not be used. Cases have come under our observation showing the bromid rash. Such treatment, as also the use of the opium derivatives, cannot be too strongly condemned. Drugs that increase the appetite and improve nutrition should be given. Iron and arsenic, particularly, answer well in these cases, as most of the patients show a secondary anemia. For a child from five to ten years of age the following prescription has been useful:

R. Liquoris potassii arsenitis.....	gtt. xlv
Extracti ferri pomati.....	gr. x
Quininae bisulphatis.....	gr. lx
M. div. et ft. capsulae no. xxx.	
Sig.—One after each meal.	

If constipation results from the use of the small doses of iron,  $\frac{1}{3}$  to  $\frac{1}{2}$  grain of the extract of cascara may be added to each capsule. If the child cannot swallow a capsule, the following may be used:

R.	Liquoris potassii arsenitis . . . . .	gtt. xlv
	Ferri et ammoniæ citratis . . . . .	gr. xlviii
	Elix. simplicis . . . . .	℥ss
	Aquæ . . . . .	q. s. ad. ℥iv
M. Sig.	—One teaspoonful after each meal in a glass of water.	

The iron and arsenic may advantageously be alternated with pure cod-liver oil—1 to 2 drams after meals—each medicine in turn being given for seven successive days. Alcohol should form no part of the medication of these children. In using the so-called liquid proprietary foods, it is to be remembered that some contain a considerable percentage of alcohol.

### HABITS

Children readily acquire habits, good or bad. Under the management of an intelligent attendant, directed by the physician, natural tendencies toward the repetition of an act may be turned to the child's inestimable advantage. In earliest infancy the habit of taking the nourishment at definite periods should be established, and as the child increases in age proper habits of sleep and rest must also be acquired. The child should be bathed at a stated time and aired at a stated time each day, and, in general, in order to fulfil the requirements of vigorous animal life, his life should conform to a routine in which there is but little variation. As our sole object is the production of a normal adult, only those habits tending toward proper growth and development should be encouraged. The habit of self-entertainment is important. An infant who requires to be constantly in arms when awake will have a tired attendant, and usually will develop into a tired and irritable child.

**Bad Habits and Their Correction.**—Among the bad habits early acquired and difficult to break are those of *thumb-sucking* or *finger-sucking* and the *use of the "pacifier."* A penalty paid by these children for such indulgence is thickened, boggy lips, due to hypertrophy of the orbicularis oris muscle and adjacent structures. Persistent sucking also produces a forward projection of the upper incisor teeth and an angular deformity of the upper jaw. The correction of the rubber-nipple and pacifier habit is readily accomplished by the immediate withdrawal of these articles. The child will experience several fretful days and make association temporarily unpleasant for those about him. The thumb-sucking habit may be corrected by having the child wear a mitten or glove made of muslin or old linen which is shirred and tied at the wrists. The Hand-I-Hold Mit (Fig. 95) answers the purpose of preventing thumb- and finger-sucking better than any other means. The child has full use of his arms, yet the hands contained in the aluminum mit are free from manipulation. If the child shows a tendency to bang the hard mits against objects about him a band of muslin containing parallel pockets in which wooden tongue blades are inserted may be wrapped about each arm at the elbow, thus preventing flexion of the forearms without interfering with shoulder or hand movements, and doing away with the necessity for the mits.

Applying bitter drugs to the fingers or thumb may be effective in controlling the habit. The tincture of aloes or a solution of bisulphate of quinin, 1 dram to 2 ounces of water, is generally used. The fingers should be repeatedly moistened with the solution. Mothers will sometimes tell us with considerable amusement that the application of the bitter drug to the finger makes no difference to the child; he appears to like the taste of quinin or aloes. The child, however, soon tires of the bitter taste, and continued use of the remedy will stop the habit. Biting the finger-nails may likewise be remedied by the use of bitter solutions.

*Picking or rubbing the finger-tips* with the fingers of the opposite hand is rather an unusual habit. It may cause considerable hypertrophy of the ends of the fingers, so that they will acquire an appearance not unlike that occasioned in cardiac disease. Mechanical restraint is our best preventive. The constant use of gloves or the application of strips of adhesive plaster will break the habit.

*Head-banging* is, fortunately, an unusual habit. It consists in repeatedly elevating and bringing the head forcibly down on the mattress when asleep. This we have seen done with sufficient force to produce vibrations in the other rooms of the house and interfere with the repose of the occupants. In one instance every means and device for preventing the banging was tried without effect. Finally the patient became such a nuisance to his family that he was made to sleep in a hammock. This was the means of curing the condition.

*Head-rolling* is practised with the child resting on the back, the head being rolled rapidly from side to side.

*Illustrative Cases.*—A two-year-old child at the Nursery and Child's Hospital immediately began this rolling whenever resting on the back. As many as 50 oscillations would be made in a minute. In this position the child continued until overcome by fatigue or sleep. We were unable to control this habit and the child passed out of the hospital with the rolling in full force.

One of our most troublesome cases was that of a child one year old who had an ear stretched to twice its normal size. During the greater part of the waking hours the child grasped and pulled at the top of the left ear.

Another patient was brought because of the habit of burrowing the right thumb into the right nostril. The nostril had become stretched to at least three times its normal size, causing a most peculiar deformity.

An eight-year-old girl developed the habit of striking her left leg at the calf with the heel of her right shoe when walking. Her stockings soon became worn and soiled, and the child presented a ridiculous appearance in public. In running or in going up and down stairs the habit was not practised. This peculiar habit had been kept up for several months. She had received the usual punishments and rewards without effect. Upon discovering that she practised the leg-banging only when walking, the writer advised a treatment which proved effective. This consisted in not allowing the child to walk for six months. She was made to run or walk rapidly whenever walking was necessary.

A girl six years old, without eczema or any evidence of irritation, had the habit of rubbing the right thigh. While walking a city block she would raise the clothing with the right hand and rub the outer lower third of the thigh for a second. This act, according to the mother, would be repeated a hundred times a day if there was no interference. The treatment suggested in this case was simple and effective. Several thicknesses of a roller bandage were used in covering up the favorite skin area. Whatever gratification was experienced by the manipulation was thus done away with, and the habit was promptly broken. The parts were kept bandaged for three months.

The most pernicious habit, that of *masturbation*, is referred to below.

It is impossible to make more than general suggestions for the correction of bad habits in children. When there is manipulation of the

mouth, the sense of taste can usually be made to aid us. In other instances restrictions of a mechanical nature may be necessary. In the ear-pulling case, a tight-fitting muslin cap was worn constantly and the right hand kept pinned to the clothing. Punishment, rewards, and ridicule all may be employed in the treatment of these cases. As a rule, however, such measures are not as effective as mechanical restraint. Bad habits as to hours for feeding and sleeping, as well as the habit of carrying a child in arms—all may be corrected by doing the right thing at the right time and having a sufficient amount of courage to persist. It is to be remembered that, regardless of age, a child is never harmed by rigid discipline properly applied.

### MASTURBATION

Before the fifth year a great many more cases of masturbation are seen among girls than among boys. After that age it is more frequent in boys. The most common method of practising masturbation in either sex in infancy is by leg-rubbing. Contact by means of the edge of a chair or the corner of a sofa or any object against which pressure may be exerted is not infrequently the means used by older girls. Manipulation of the parts, while only occasionally seen in girls, is the usual method of boys after the third year.

Our youngest patient was a female child six months of age who was a "leg-rubber," and who evidently passed through a complete orgasm.

By many the habit will be indulged in several times a day.

In boys the primary causes of the practice are an elongated foreskin, adherent prepuce, and phimosis. The handling of the parts necessary to keep the uncircumcised clean is an exciting factor. In girls, vulvitis and vaginitis, and adhesions of the clitoris, with the retained smegma and resulting irritation, are frequent causes. It is a popular notion that thread-worms may be an exciting factor, but among many cases of masturbation and many cases of thread-worms we do not recall seeing both conditions in the same child.

**Prophylaxis.**—Masturbation is much easier to prevent than cure. In boys, prevention lies in keeping a clean, free glans, which in the great majority of male infants can be obtained only after proper surgical procedures. The elongated, thickened, uncut portion of the foreskin often seen below the glans after a ritual circumcision is but little better than a free, elongated prepuce. Slitting of the foreskin on the dorsum gives a condition very similar in character to that of a long, redundant foreskin. In girls, prevention to a certain degree consists in keeping the parts clean through washing them once a day with great gentleness, and the free use of non-irritating absorbent powders. A powder composed of equal parts of powdered starch and oxid of zinc gives very satisfactory results.

**Treatment.**—When the habit of masturbation has been once established, the first step is to eliminate the cause, if it can be discovered, and put the parts in a normal condition. Circumcision in boys, and releasing the adhesions of the clitoris in girls, with the maintenance of cleanliness and as little manipulation as possible, are absolutely essential.

The urine should be examined, and if found highly acid, should be

corrected by diet and by the use of bicarbonate of soda, 60 to 120 grains being given daily, according to the age of the patient. If red meat has formed a considerable part of the diet, the quantity should be reduced and given not oftener than three times a week.

Having removed all possible sources of local irritation, we are in a position to use restrictive measures, as it is through such treatment only that a cure will finally be effected. If the practice is prevented the habit will soon be forgotten. The older the child, the more difficult will be the cure. The restrictive measures employed depend to a considerable extent upon the age, sex, and method of practice. In the case of young children of both sexes who practise leg-rubbing a large napkin of some coarse material, or a towel, should be placed over the napkin usually worn, and applied in the same way, so as to keep the legs widely separated. After the napkin age a large towel may be used, if necessary, for the same pur-

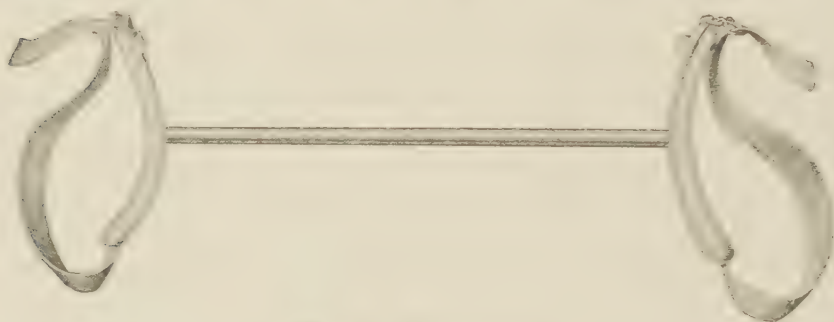


Fig. 94.—Knee-crutch.<sup>1</sup>

pose, or the knee-crutch (Fig. 94) may be employed. Some children will indulge only when in a certain chair or in a certain position.

*Illustrative Case.*—A very troublesome case in a girl seventeen months old had been treated without success for several weeks, when it was discovered that the child practiced the habit only when in her high chair, as by leaning forward and grasping the projecting arms she managed to bring the necessary pressure to bear upon the genitals. The use of the chair was discontinued, and there was no further trouble.

Another girl six years of age was an inveterate masturbator who had been treated unsuccessfully by several physicians. The act was repeated daily, sometimes two or three times a day, usually, for instance, such as by pressure against the corner of a table, sofa, or chair. When it had she indulged in the practice by manipulation. She had become more and more excited, and as she was a member of a prominent family, great concern was felt for her. The external genitals were congested and swollen as a result of the long irritation, otherwise they were normal. It seemed that here was a case where medical treatment was the price of safety. The gravity of the condition was apparent, and the parents readily agreed to the suggestion that the child should never be left alone. The mother and the nursery maid took turns in being with the child at all hours. A trusty and intelligent woman was selected for the night watch. Directions were given that no pressure be made on the habit, but that the child should be severely punished if the practice was attempted. This, however, was not needed. This child, as is the case with all other children, masturbated in secret, and as she was never left alone, stopped the practice. She was given suitable food, teaching by a pleasing kindness was begun, and hard play was soon advised, as her physical improvement was rapid. As there was no further tendency to masturbate, the night watch was dropped after six months. The child was kept under the closest observation, however, for a month longer time. Co-operation to such a degree as in this family may, however, rarely be secured.

<sup>1</sup> Made for the author by George Ernsold Co., 201 East 23d St., New York City.

Older children who practise manipulation of the parts can usually be watched during the daytime, but the habit is frequently indulged in on going to bed, after the lights are out, and in the early morning, particularly when prevented during the day. In such instances it has been necessary to advise mechanical restraint. An inexpensive and effective means is a piece of tape, which is tied in the center around the child's neck in a flat knot, leaving the two ends long enough to be securely tied around the wrists, so as to allow a free movement of the hands above the umbilicus. The child can use the handkerchief, and adjust the bed-clothing, but cannot touch the genitals. If the patient is a girl and a masturbator by contact with any object, or a leg-rubber, a large bath towel, if worn like an infant's diaper, will aid materially in discouraging the practise. A brace constructed of steel, with a hinge-joint to allow the arm to be extended to an angle of about 45 degrees, has been used with success in a few cases. This brace is worn only at night.<sup>1</sup>

The "*Hand-I-Hold Mit*."<sup>2</sup>—As a means for the prevention of scratching, thumb- and finger-sucking, nose-boring, ear- and lip-pulling, and masturbation the "*Hand-I-Hold Mit*" renders good service. The child has free use of the arms and the fingers are movable inside the mit. In eczema, however, the hard mit may serve as a very attractive means of rubbing the diseased surfaces.

#### HICCUP

Hiccup is a spasm of the diaphragm, usually due to gastric irritation from the distention of the stomach or intestine with gas, or overloading of the stomach with food. Under such conditions the spasm is usually of little consequence, and may readily be relieved, if the attack is prolonged, by an enema of soap-water and a laxative dose of rhubarb and soda. (See p. 100.) With any grave illness, however, persistent hiccup is a symptom of serious import. Hysterical girls often have hiccup to quite an alarming degree. The attack usually follows a period of unusual excitement. In these cases from 20 to 30 grains of bromid of soda repeated in from twenty to thirty minutes will usually control the spasm.

#### INFANTILE CONVULSIONS

A convulsion consists of a temporary loss of consciousness, associated with clonic contractions of various muscles of the body.

<sup>1</sup> This device had its origin with Dr. Gerald Webb of Colorado Springs.

<sup>2</sup> Manufactured by R. M. Clark & Co., Newton Centre, Mass.

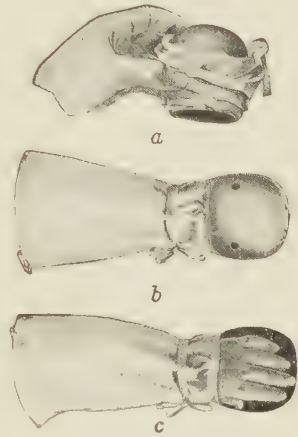


Fig. 95.—The Hand-I-Hold Babe Mit and method of applying: a, First, roll sleeve over ball to expose opening, then insert the child's hand; b, second, tie tape at wrist and pin with safety-pin to dress at elbow. If mit is not held in place firmly enough, use a broad piece of cheese-cloth in place of tape. Bind this firmly around the wrist and tie; c, x-ray view showing freedom of hand.

During the early days of life a convulsion is always of serious import, as it frequently is the result of a birth trauma and suggests a serious brain lesion which may terminate in early death or result in spastic paralysis or idiocy, or both.

**Etiology.**—Infants and young children are peculiarly susceptible to convulsions because of lack of inhibitory control, due to insufficient development of the motor centers in the cortex, which, in consequence, discharge the more readily. A convulsion may be looked upon as a motor discharge affecting either the entire muscle structure or only a portion thereof. Convulsions, therefore, indicate cortical irritation. The irritation may be due to injury of the brain structure, as previously mentioned, birth trauma being the usual cause of convulsions in the very young, or may be the result of meningitis, tumors, hydrocephalus, or trauma in later life, such as a fall or blow on the head.

*Illustrative Case.*—An infant of eleven months fell from his baby carriage to the stone pavement. Convulsions, repeated and severe, continued until the bleeding area in the cortex was located, the skull was opened, and the bleeding vessel was tied.

Heredity as a predisposing cause of convulsions apparently plays but little part, except in epilepsy.

Convulsions may be due to indirect causes.

*Rachitis* is a most fertile contributing cause. The reason for this is not clearly understood. Various theories have been advanced. Probably the nerve-centers share with other portions of the body in malnutrition and lack of development. In a rachitic individual the inhibitory control is of a very low order. In many rachitic children it is surprising how little irritation may bring on a seizure.

The subject of tetany is discussed on p. 542.

*Gastro-intestinal Cases.*—An immense majority of the cases of convulsions coming under our notice have been due to gastro-intestinal disorder, most frequently in the form of acute indigestion due to unsuitable articles of diet. Rachitic children have supplied many of these cases.

If the irritation is sufficiently severe convulsions may occur in the most robust.

Thus, a boy of three years had repeated convulsions until he was relieved of 43 large round-worms (lumbricoids).

Convulsions of intestinal origin may be due either to the effects of toxins elaborated by abnormal digestive processes or to direct intestinal irritation.

A case of the latter type was seen in the New York Infant Asylum, where a child had repeated convulsions and died in a seizure. At the autopsy a piece of a small orange was found in the intestine.

*Thymus Gland.*—Enlargement of this gland has been present in a number of personally observed cases of fatal convulsions. The majority of the cases have been seen in hospital work, where the enlargement of the thymus could be proved at autopsy.

*Convulsions of toxic origin* may usher in pneumonia, scarlet fever, or any of the acute infectious diseases.

Uremic convulsions are to be classed under this heading.

Convulsions are frequently the termination of a prolonged bronchopneumonia or enterocolitis.

*Convulsions in the Newborn.*—Particularly disturbing cases are those of the newborn, who do not develop convulsions, but grimaces and slight twitchings of the face, with a tendency to stupor and irregular respirations, all very bad signs indeed in a newborn baby. These cases may go on to the development of true convulsions, but many never show more active symptoms than those mentioned. Particularly unfavorable is the outlook if these various manifestations are combined even to a mild degree. Sooner or later the child appears for treatment because of retarded mental development.

Dr. W. Sharpe, of New York, has performed the decompression operation on several of these infants; those with active nervous symptoms, and those in which there was nothing but defective mentality with a suggestive early traumatic history. The extent and degree of the lesions, hemorrhage, cysts, etc., which are to be found with comparatively slight attending manifestations have been surprising.

*Dentition* may indirectly be a cause in producing indigestion, with resulting irritation and toxemia.

The writer has had 3 patients who had convulsions with every tooth cut and without demonstrable associated digestive disorder.

#### *Phimosis:*

Two boys had repeated convulsions which subsided when they were circumcised and relieved of much smegma and local irritation.

#### *Asphyxia:*

A strong boy nine months of age was taken in bathing by his mother. A large wave enveloped and separated them. The baby was unconscious when found. With returning consciousness he passed into a convulsive state which lasted several hours. Evidently there was a cerebral hemorrhage, as the child is now an imbecile and had been perfectly normal before.

*Tetany* (p. 542).—Severe convulsions, although exceptional, may be present in severe tetany. In tetany the manifestations are usually those of continuous tonic contractions. The association between rickets and tetany is elsewhere discussed (pp. 540–543).

*Repetition.*—With each convulsion, of whatever origin, the inhibitory control is lessened, and each succeeding seizure requires less cortical irritation than its predecessor. Gowers has stated that 30 per cent. of the cases of epilepsy have their origin in so-called simple infantile convulsions.

**Manifestations.**—Convulsions vary greatly in their manifestations. The seizure may be so slight as to be scarcely recognized. These are the so-called “inward” convulsions. There may be a momentary spasm of the body, with slight twitching of the face and extremities, after which the child appears normal or sleepy and dull for a few moments. The convulsion, on the other hand, may be most intense and prolonged. The onset is sudden. There are usually twitchings of the muscles of the face and

inco-ordinate movements of the extremities. There are alternate contractions and relaxations of all the muscles. The eyes become set and the child is unconscious. There is frothing at the mouth and the breathing is stertorous and labored. The child may rapidly pass out of the convulsive state or become quiet, with infrequent twitchings, and thus remain for hours.

In a fatal case the temperature was  $111^{\circ}$  F.—as high as the thermometer would register. The temperature was reduced, and the child lived eight hours, but never regained consciousness.

In many instances the child passes from one convulsion into another. During active treatment, such as the hot bath and chloroform administration, the seizure will apparently cease, and the child will show signs of returning consciousness. As soon as the treatment is discontinued the convulsion is again repeated.

**Prognosis.**—We have seen a considerable number of cases of fatal convulsions, and do not look upon any attack with unconcern. The prognosis depends entirely upon the general condition of the patient and the direct cause of the convulsions. In the convulsions of scarlet fever, pneumonia, and gastro-enteric disease there is usually but little danger to life. If the attack is due to an enlarged thymus, the ultimate prognosis is unfavorable unless the case can receive the benefit of x-ray therapy between seizures.

A convulsion may be serious in its immediate, as well as in its remote, effects. One convulsion may produce cerebral hemorrhage, which may change the entire future of the patient, producing spastic paralysis or idiocy, or both. About 10 per cent. of the cases of epilepsy originate in indigestion—the so-called “dention convulsions.” In these rachitis plays an important etiologic part.

Under the senior author's observation several children under one year of age, in apparently good health, have died as the result of convulsions. In 1 case was found, upon autopsy, as above noted, one-fourth of an orange in the small intestine. In 6 the convulsions were due to enlarged thymus glands. In 3 of these cases there had been no previous symptoms indicating the existence of this condition. The patients were strong, robust infants. Two were breast fed. The diagnosis was confirmed by autopsy in 4 cases, which included the breast fed.

**Treatment.**—*Immediate Treatment.*—When a convulsion occurs the patient should at once be undressed and placed in a mustard bath (p. 843) at a temperature of  $105^{\circ}$  F. While in the bath he should receive brisk friction of the trunk, and particularly of the extremities. At the same time an attendant may give an enema of soap-water. In a great majority of the cases in less than five minutes the child will show evidence of a return to consciousness. As soon as he can swallow, 2 teaspoonfuls of castor oil should be given.

After a seizure the patient should be kept very quiet for twenty-four to forty-eight hours. An ice-bag or cold cloths should be applied to the head, and a guarded hot-water bottle kept at the feet.

**Diet.**—The diet should be the lightest. Chicken broth, weak beef-tea, and thin gruels should constitute the nourishment for a day or two.

A second seizure is more easily produced than the first, and a third easier than the second.

*The Use of Chloroform and Sedatives.*—In case the attack is a very severe one, when the child is slow to respond or when he passes rapidly from one convulsion to another, chloroform inhalations, regardless of the age, should be given in sufficient quantity to prevent the seizures until the intestinal canal can be emptied, and sufficient sodium bromid and chloral can be given by mouth or rectum to prevent a recurrence.

*Rectal Medication.*—To a child under one year of age 8 grains of sodium bromid and 3 grains of chloral may be given by rectum in 2 ounces of mucilage of acacia. After the first year from 3 to 5 grains of chloral may be given with 10 to 20 grains of sodium bromid. It is best to attach to the syringe a soft-rubber catheter (No. 18 American) or a small rectal tube. The catheter should be introduced for at least 9 inches if possible, so that the solution may be carried to the descending colon, where it will be retained better than if introduced with the small hard-rubber tip just within the anus. The bromid and chloral may be repeated at intervals of two to six hours, as required to control the convulsions, and continued in diminished doses as long as there are noticeable signs of nervous irritability, such as twitching and involuntary muscular contractions.

*Sedatives Internally Administered.*—If the child can swallow, 5 grains of sodium bromid in  $\frac{1}{2}$  ounce of water may be given, and repeated at intervals of one to four hours until the convulsions are controlled.

*Hypodermic Medication.*—Morphin hypodermically is rarely required. It should be used only when other means fail. A child one year of age may be given 1/30 grain, and this may be repeated in two hours, though usually it will not be required. Under one year, 1/50 to 1/40 grain may be given; under six months, morphin should be omitted.

### LARYNGISMUS STRIDULUS

In laryngismus there is a spasm of the larynx involving the muscles of both inspiration and expiration. This rarely occurs after the eighteenth month.

**Etiology.**—The part played by the thymus in laryngismus stridulus may be very important. The writer has seen 2 typical cases of laryngismus end fatally, with enlarged thymus as the cause of death. An x-ray examination of every case of laryngismus is essential.

Laryngismus is very frequent in rachitic and poorly nourished children. The seizures are induced by fright or anger, and the attacks cease in many instances with spoiling the child, allowing him to have his own way, by improving his nutrition, and following the use of belladonna and bromids. If the thymus were the all-important factor in all cases we would not expect a response to the treatment outlined. Further, autopsies on infants who have had laryngismus do not always show involvement of the thymus. We must continue to look for the explanation of many of our cases in their belonging to the family of spasmodic diseases.

**Morbid Anatomy.**—No definite lesion has been found to account for the spasm, which occurs in association with a wide variety of morbid states, as well as without any apparent pathologic condition.

**Symptomatology.**—The attacks are usually excited by some disturbance of the child's mental state. Thus, crying ushers in most of the paroxysms. The child attempts to draw in the breath preparatory to the cry, and the laryngeal spasm begins. There may be several short, whistling inspirations, each attempt being less successful than the first. The whole procedure requires but a few seconds. The face is first red, then blue and cyanosed. The absence of respiration continues for an indefinite time—usually but a few seconds. Then the spasm subsides, and the child "catches" his breath, which is signaled by a short inspiratory crow, followed by a series of longer and more successful inspirations. The child cries, the blood becomes oxygenated, the normal color returns, and all is well until the next attack.

The attacks may be milder or more severe than the foregoing. In the mild cases complete apnea does not take place. In others the laryngeal spasm is complete from the onset. The child attempts to cry, and falls into what the mother calls "a faint," becoming thoroughly relaxed and unconscious. Such attacks as these are always cause for much anxiety, as they suggest strongly the possibility of enlarged thymus and sudden death. The period of unconsciousness may persist for a variable time, ranging from a few seconds to a minute or two.

A patient three months of age had from twenty to thirty seizures a day, and the attacks ceased only with an improvement in the child's general condition.

**Diagnosis.**—The diagnosis is made by the sudden onset of difficult breathing, the rapid return to normal breathing, and the continuation of normal, unimpeded breathing between the attacks. In susceptible subjects the laryngismus may occur with whooping-cough and with acute catarrhal laryngitis. These diseases have a distinct symptomatology of their own, and need cause no confusion.

*Congenital Laryngeal Stridor.*—The obstruction is of a mild degree and present a greater part of the time. It is relieved during crying and at its worst when the child is asleep (p. 540).

**Prognosis.**—The prognosis, in the main, is good, but when one has seen sudden death in infants in private families and others in hospital work, all with the laryngeal spasm association, he does not have the confidence in the outcome of a convulsion that is claimed by many writers.

Prompt results under treatment, except in mild cases, are the exception. The attacks may continue, varying widely in number, for several weeks. The intervals between attacks in favorable cases lengthen and the attacks become less severe.

**Treatment.** The *management* is divided into two parts: the immediate relief of the spasm, and the treatment of the patient's debilitated physical condition, if such condition exists. From our observation, the most satisfactory method of relieving spasm in the mild cases—those in which the unconsciousness is of but a few seconds' duration—is by inverting the patient and at the same time slapping him on the back. Splashing cold water in the child's face may be of advantage in some cases, but we have found it of but little service. In cases which are sufficiently prolonged to resist inversion and slapping on the back, a quick resort to alternate hot and cold tub baths, at 60° and 120° F. respectively, has

been useful. If recovery is not prompt, intubation or tracheotomy should be performed, followed by attempts at artificial respiration.

*Drugs.*—Between the attacks the patient should receive small doses of antipyrin and sodium bromid. Under six months of age  $\frac{1}{2}$  grain of antipyrin and 2 grains of sodium bromid may be administered in 1 dram of cinnamon-water, six doses being given in twenty-four hours. From the age of twelve months to the third year 1 to 2 grains of antipyrin with 2 to 4 grains of sodium bromid may be similarly administered, six doses being given in twenty-four hours. The only disadvantage in the use of the drugs lies in the fact that these children may have faulty digestion, which condition may be aggravated by the sodium bromid. When this effect is observed, the bromid should be omitted and the antipyrin given alone. Antipyrin apparently never produces any unfavorable effects upon gastric digestion.

*Rectal Medication.*—Colon medication may be of considerable service in these cases, and, when indicated, bromid and chloral are our most reliable sedatives. To a child of six months or under, 1 grain of chloral with 5 grains of sodium bromid may be given in 2 ounces of mucilage of acacia by the bowel; to a child of six to twelve months, 2 grains of chloral and 8 grains of sodium bromid in 3 ounces of mucilage of acacia; to a child of twelve to twenty-four months, 2 grains of chloral and 10 grains of sodium bromid may be given in 2 ounces of mucilage of acacia. The bromid and chloral should not be administered oftener than once in six hours.

The method of administration is as follows: A large soft-rubber catheter or a small rectal tube, attached to a Davidson syringe, should be introduced at least 9 inches into the rectum, so as to reach the descending colon. The child should rest on the left side, with the buttocks elevated on a pillow so that they are higher than the shoulders. After the withdrawal of the tube the position of the child should be maintained for several minutes in order to aid in the retention of the fluid.

*After the Attack.*—All sources of reflex irritation should be removed. If difficult dentition is a factor, the troublesome tooth should be brought through the gum. Adenoids, thread-worms, adherent prepuce, and constipation all should receive proper attention. Particularly must these children be kept free from all sources of mental excitement, such as loud talking, the overattention of adults, and the rough, active play of older children.

*Diet.*—The dietetic management of debilitated, rachitic children suffering from laryngismus is the same as that of other debilitated children. (See Malnutrition, p. 137.) In general, they should be given as high a protein diet as is compatible with their digestive powers. Thus, if there is intolerance of cow's milk given in suitable dilution, there should be no hesitation in advising the employment of a wet-nurse. If the proprietary foods are given, they should be used with cow's milk. For children over one year of age cow's milk, cereals containing a large amount of nitrogen, such as oatmeal and soy-bean gruel, soft-boiled eggs, beef juice, and scraped beef should form a large part of the diet.

*Antirachitic Treatment.*—To meet the rachitic element common in cases of this type cod-liver oil should be administered, if the digestion

permits, as a routine procedure. In addition, calcium chlorid or bromid is indicated as in the treatment of tetany (p. 546).

### CONGENITAL STRIDOR

Attention was first called to this disease by Rilliet and Barthez in 1853.

**Etiology.**—Various explanations have been offered as to the cause of the stridor. It is probably due to a bilateral abductor insufficiency, a general relaxation of the larynx, with the result that during inspiration there is a partial collapse of the muscular equipment and the lumen of the larynx is narrowed in consequence. As the child grows older the parts enlarge, the tissues become firmer, a better nerve control is established, and the inspiratory obstruction is gradually relieved.

**Symptoms.**—The condition is characterized by an inspiratory crow, slight in character but fairly constant when the child is quiet and asleep. It usually disappears under stress, such as crying. The sound produced has been variously described as a crow, a cluck, a croak, etc. It appears at birth or within a few days, and continues for months.

In a very pronounced case the stridor continued until the child was eighteen months of age. So noisy was the breathing during sleep that it could be heard in an adjoining room with the doors closed.

As a rule the stridor gradually lessens and ceases before the child is one year of age.

**Diagnosis.**—So characteristic is congenital stridor that it can hardly become confused with anything else. Beginning at birth and continuing with but little intermission in pronounced cases, it is most pronounced when the child is quiet and when asleep. It disappears under stress. There is no hoarseness; no air-hunger. The obstruction involves inspiration only and is not sufficient to produce discomfort.

x-Ray is of value in the differentiation of thymic enlargement.

**Treatment.**—No treatment is required.

### SPASMOPHILIA AND TETANY

**Definition.**—The term "spasmophilia" was originated by Finkelstein and is applied to a state of abnormal nervous irritability in infants, the expression of which is in one or more forms of spasm, principally holding the breath, convulsions, carpopedal spasm, and laryngospasm. By some authors "spasmophilia" is used to designate only the latent form of this disease to which, as a whole, is applied the name "tetany."

**Etiology.**—Spasmophilia in all its forms is most common in bottle-fed infants after the third month. Heredity exerts some influence in the causation and cases are not uncommon among several children of the same parents. Spasmophilia and rickets are very closely associated, and spasmophilia, like rickets, has been ascribed to a deficiency of lime salts in the system. Quest has demonstrated the existence of such a deficiency in the brains of children dying from tetany. Marriot and Howland have shown a marked reduction of calcium in the blood of infants with marked cases, and McCallum and Voegtlin have shown the same condition in the blood of animals with experimental tetany.

induced by extirpation of the parathyroids, thus confirming Escherich's view that the disease might be due to hemorrhages or other lesions in these glands.

Toxemia from infectious diseases or digestive disorders conduces to outbreaks of spasmophilia, and most of the active manifestations are observed in the late winter and early spring.

The pathologic findings, apart from the presence occasionally of hemorrhages in the parathyroids, are the lesions of associated rickets.

**Symptoms.**—Lowenburg conveniently divides spasmophilia into two types: *latent spasmophilia* and *manifest spasmophilia*. Latent spasmophilia is recognized by the presence of abnormal electric reactions together with reflex phenomena of nervous origin which may be elicited by mechanical stimulation. The amount of electric current required to produce a kathodal opening contraction in the muscles of a spasmophilic infant is always less than the amount necessary to produce the same reaction in a normal infant. Such response to a current of less than 5 milliamperes indicates positive spasmophilia. *Chvostek's sign* is an evanescent facial contraction elicited in spasmophilics after the second month of age, upon tapping the cheek just below the zygomatic process of the superior maxilla. *Trousseau's sign* is the occurrence of a characteristic carpal contraction in an extremity following ligation of the wrist or ankle in such manner as completely to occlude the blood-supply. The *peroneus phenomenon* obtained by tapping the peronei muscles consists in a drawing up of the foot with the toes raised and slightly elevated. *Theimich's lip sign* consists in a protrusion or pouting of the lips, elicited by tapping the orbicularis oris. So-called manifest spasmophilia is characterized in addition by laryngospasm, carpopedal spasm, eclampsia or convulsions of a general character, and by a peculiar induration (hard edema) of the hands and feet. The laryngospasm occurs upon slight disturbance of the child's nervous balance and may occur even during sleep. Laryngospasm is common during fits of crying and differs from congenital stridor particularly in the peculiar crow which in spasmophilic laryngospasm follows a state of apnea and cyanosis of possibly a full minute's duration. Many attacks in one day are not uncommon.

The carpopedal spasm consists in tonic contractions of the hands and feet. The larger joints are held flexed, the thumb adducted, and the foot typically in a position of equinovarus.

Eclampsia in spasmophilics is marked by the occurrence of clonic convulsions independent of brain lesions, nephritis, and epilepsy.

The hard edema of the hands and feet is supposedly a vasomotor phenomenon.

**Diagnosis.**—Among the conditions frequently confounded with spasmophilia are epilepsy, tetanus, pertussis, enlarged thymus, congenital stridor, laryngeal stridor, and retropharyngeal abscess. Of these, epilepsy is most difficult to exclude. The typical reflexes and electric reactions of spasmophilia are of the greatest value for differentiation in doubtful cases.

**Prognosis.**—Under intelligent care and feeding the outlook is good. Progress may be confirmed by the observance of a steadily closer and closer approximation to the normal in reflexes and electric response.

**Treatment.**—Maternal nursing and wet-nursing are of greatest value not only in preventing tetany, but in limiting its progress. Holt has insisted that to infants under eight months of age who give symptoms of tetany woman's milk should be supplied if possible. Aside from this the fundamental management of spasmodophilia is essentially that of rickets. Most cases do well on cod-liver oil provided the oil can be borne by the digestion, which is probably most tolerant if the oil is given about half an hour after the feeding. Calcium bromid in simple solution is generally recommended as the sedative of choice. The dose of the salt should be sufficient to control the spasm and may vary from 20 to 40 grains daily. Where this is unobtainable or ineffective, chloral, chloroform, or even morphin hypodermically in dosage up to 1 100 grain, may be given. Gastric and intestinal lavage are of value when there has been overloading of the digestive tract or toxic absorption therefrom; and when there are general convulsions or pronounced spasms of the extremities warm baths are to be employed.

#### TETANY

Frank, active tetany is characterized by persistent tonic contractions of the muscles, usually of the upper and lower extremities. In rare instances cases will be seen in which the peculiar tonic contraction involves all the muscles of the body and may assume the character of a general convulsion.

**Etiology.**—This affection is rarely seen after the second year, though cases are occasionally reported as occurring in older children.

Tetany is most commonly seen in marasmic infants suffering from intestinal derangements of a not very active type. Occasionally it occurs in well-nourished children. Rachitis is present in the majority of cases. In nearly all cases seen by us malnutrition or pronounced digestive disturbance has been present.

*Illustrative Case.*—A baby three months of age was given a high fat mixture (7 per cent.) in order to supplement the mother's milk. After a few feedings the child developed convulsions, with the typical tonic contractions. Under treatment the mental condition cleared, but general muscle contractions continued, which evidently caused great pain. The child was absolutely rigid, with both the lower and the upper extremities in the characteristic position, which continued for several days.

The actual cause of this disease is still obscure, but from time to time new light is thrown upon the subject. The majority of the cases are seen during the winter and early spring months, and, owing to this fact, Kassowitz's theory of a respiratory infection received strong confirmation. Escherich, Ganghofner, and others found that manifest tetany and laryngospasm in children increase during the beginning of winter, and gradually reach their highest point in February and March, after which they diminish in frequency until midsummer, when the incidence is practically zero. Escherich's statistical table of 240 cases shows:

MONTH.....	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Number of cases..	29	51	59	45	10	7	0	1	4	2	21	16

In extensive work Wilcox, of New York, found that during the months of December, January, and February he obtained the greatest number

of middle-grade reactions, while 3 of his cases of frank tetany occurred in February and 2 each in December and January. The incidence of hyperirritability was greatest in December.

It appears, from the literature on the subject, that the frequency of tetany varies considerably in different countries and cities; in some localities the cases are almost frequent enough at least to suggest an epidemic. In infancy males seem to be more frequently affected than females.

According to Fischl fully 63 per cent. of subjects are rachitic; this, of course, will vary in different countries. Kassowitz demonstrated the similar relation to the time of year existing between the incidence of tetany and that of the rachitic affections. He came to the conclusion that there must be an intimate relation between the two. Wilcox concluded that the child's irritability varies directly with the general condition of nutrition, and that the well-developed and nourished respond much less readily to galvanism than those underfed and below the normal weight.

Seligmüller, Pott, Thiemich, and others became convinced that spasmodophilia (tetany, laryngospasm, and eclampsia infantum) possesses in a well-marked degree the characteristics of heredity. Thiemich's decision has come from a dozen observations at the Breslau Kinderklinik relating to families in which the mother had laryngospasm or eclampsia in her childhood, and exhibited a pronounced facial phenomenon as a residuary latent symptom.

Cold, intestinal parasites, bowel infections, chronic intestinal disturbances (of which there were fully 73 per cent. in Fischl's cases), and an enlarged thymus have all, in turn, been regarded as causative factors. Concerning the latter theory, which was advanced by Paltauf, one must consider the contrast existing between the pasty "lymphatic" type and the lean and imperfectly developed child, in which the evidences of the spasmodophilic diathesis are almost solely found.

It seems improbable that the disturbance has anything to do with the sugar, fat, or protein, since no harm results by adding any of these substances to a diet consisting of carbohydrates, which tend to diminish irritability. On the other hand, whey acts precisely as does cow's milk in increasing both mechanical and electric irritability, and it might be supposed that it contains in solution a substance which is concerned in the production of the symptoms.

Considerable evidence has been accumulated of late concerning calcium metabolism and its relation to tetany. So far the conclusions arrived at by different observers vary, but, nevertheless, there are a few points on which a unanimous opinion exists. Experiments in physiology have shown that the peripheral nerve irritability can be influenced by salt solutions, and the researches of Holb showed that it is not one salt alone, but the interaction with other salts, which influences nerve irritability; either a diminution of the sodium or an increase of the calcium diminishes irritability. This fact suggested that the etiology existed in salt metabolism.

Due to these observations Czerny commenced some experiments on the chemical examination of brains, which were carried out by West, who showed that there was a diminution of the calcium content of the

brains of children with tetany, and further pointed out that, by feeding calcium-poor food to dogs, the irritability of the peripheral nerves was diminished, while Sabbatini demonstrated that the application of calcium to the cortex diminished the electric excitability. Stoeltzner, attempting to repeat these observations, obtained somewhat contradictory results. Rosenstern, along with other observers, approached the subject from the clinical aspect and fed calcium salts in cases of the spasmophilic diathesis, producing a remarkable diminution in the nerve irritability, the effect of which disappeared in twenty-four hours, the same results being obtainable, only more rapidly, by the intravenous injection of the calcium salts.

An examination of the blood in this condition has shown a considerable diminution of calcium, while, on the other hand, there is known to exist an increased output of calcium in the urine and feces. Similar results have been obtained in this country by McCallum and Voegtlin in experiments on parathyroidectomized dogs. Further explanation is offered in postoperative tetany in adults. When the parathyroids have been wholly or partially removed the symptoms ensuing are relieved by the administration of calcium by mouth, the effect passing off in a few hours. In infantile tetany less apparent result has been obtained by the administration of calcium by mouth.

Howland and Marriott<sup>1</sup> have shown that reduction of calcium content in the blood causes tetany, frank evidences of tetany occurring when the reduction reaches 6 to 7 mg. of calcium per 100 c.c. (The normal calcium content ranges approximately from 9 to 11 mg. per 100 c.c.)

**Pathology.**—No constant lesions have been located that may be associated with tetany. Thus far no uniform anatomic changes in the parathyroids have been reported. The most usual findings are hemorrhage, recent or old, cysts, and staining. Fischl in fatal cases found tuberculous meningitis, bronchopneumonia, hemorrhagic infiltration of the brain, edema, and chronic intestinal inflammation. In one case seen by the writer there was a pachymeningitis. Autopsies on many infants in whom tetany has been present fail to reveal any diseased condition of the nervous system.

**Symptoms.**—The appearance of a child with tetany is characteristic. The symptoms vary only in their intensity.

In mild cases there may be simply an adduction of the thumb on the palm of the hand, giving rise to the term "the accoucheur hand." With this phenomenon there will usually be an extension of the feet, caused by marked contraction of the tendo achillis.

In the more pronounced cases the hands are flexed on the arms, and the fingers are lightly contracted over the adducted thumb (Fig. 96). The feet are held in a marked extended position, with the toes flexed toward the plantar surface of the foot. With the second and third row of phalanges extended, a similar phenomenon is also sometimes seen in the fingers. Usually the joints at the elbow, shoulder, hip, and knee may be moved without discomfort. Attempts at forcing the other joints to the normal position are met with resistance and evidence of pain. The knee-jerk is markedly exaggerated. There is an increased response

<sup>1</sup> Quart. Jour. Med., xi, 1918, p. 289.

to both the galvanic and faradic current. Muscle irritation may or may not cause various phenomena. Trismus has never been present in our cases.

*Muscle Irritability.*—Evidence of muscle and mechanical irritability may be demonstrated by the following tests. (See also p. 541.)

The *Chvostek sign* depends on the heightened irritability of the facial plexus which, on being tapped with the finger or a percussion-hammer midway between the zygoma and the angle of the mouth, produces a contraction at the ala of the nostril, the angle of the mouth, and, in marked cases, the inner canthus of the eye and eyebrow. This reaction is given various grades of importance by authors. Thiemich's conclusions are that "the facial should be stricken from the list of nervous stigmas, and must be regarded even in late childhood as a pathognomonic sign of latent tetany, even if this disease remains continuously a symptomless anomaly of the nervous system." This sign was found in but one of Wilcox's cases. It will be found in perhaps half of all cases.

*Schultz's sign* is produced by stroking the skin over the zygoma, which in extreme cases of tetany produces a contraction similar to the Chvostek. In comparatively few cases can this sign be demonstrated.

*Trousseau's Sign.*—Shutting off the blood-supply in the elbow or groin through pressure is followed, after a varying interval, by the typical carpal or pedal spasm.

**Duration.**—Marked tetany, under our observation, has lasted from a day or two to two to six weeks. A return to the normal is usually slow. Cases that are entirely relieved in less than a week are extremely rare. When the disease disappears rapidly, we are not sure that it may not return, possibly in a more severe form.

**Diagnosis.**—The diagnosis is not at all difficult, and is made by the characteristic contraction of the hands and feet, which occurs in no other condition. While perhaps the nervous phenomena might suggest cerebral disease, the absence of mental symptoms excludes it.

*Electric Irritability.*—In tetany the electric reactions may be said to be of distinct diagnostic value. It seems very difficult to establish exactly normal reactions for children, as many will react low one day and high another, and then again the reactions vary with changes in the digestive and metabolic processes. It must be kept in mind that the electric reactions are not always diagnostic of tetany, but, on the other hand, there is now no doubt that, by this method of diagnosis, cases hitherto not suspected of tetany may be brought to correct diagnosis. Just what exact electric findings are essential to a diagnosis is



Fig. 96.—Hand in tetany.

still a matter of dispute. Escherich believed that in normal children only KCC appears under 5, and that only occasionally may anodal closure be present with this current strength.

Wilcox has cited the grades of electric irritability as follows:

1. Normal, in which KCC occurs under 5. Sometimes ACC is found at 5 or just below it.
2. The middle grade, or anodal hyperirritability, in which KCC is less than 5, and AOC is less than ACC and less than 5.
3. Tetany, in which all four reactions are less than 5. A suggestive tetany is the occurrence of AOC less than ACC and the appearance of KCC tetanus.

The incidence of tetany varies, due presumably to the varying attitudes of the observers as to what constitutes a true diagnosis. Numerous authors give figures varying from 6 per cent. down to 0.7 per cent. in artificially fed children under three years of age.

*Technic.*—A simple and most efficient instrument is one supplied by Wappler & Co., of New York. It consists of dry cells which supply a galvanic current and contain a switch for reversing the polarity, a rheostat for controlling the current, and a balanced milliamperemeter measuring from 0.2 to 10 milliamperes.

The patient is laid in bed with the feet directed toward the observer, who grasps the right foot with the left hand, in such a manner as to be able to detect the slightest response occurring in the flexor tendons or the ankle or toes. The negative electrode is placed upon the abdomen of the patient, while the positive one is controlled by the right hand of the operator, who at the same time regulates the rheostat with his elbow. The test should always be begun with a current strength sufficient to produce muscle response and then gradually reduced. If the opposite is attempted, the lowest point will invariably be passed. One should always consider the individual skin resistance, which varies directly with the amount of fat and is rapidly reduced as the test progresses.

**Prognosis.**—The prognosis depends entirely upon the condition which accounts for the tetany, which is to be looked upon as a symptom and not a disease.

The eclampsia case to which reference has been made came near a fatal termination.

Fatal cases have been recorded as occurring with thymus gland involvement, and here again we have enlarged thymus as a cause of death.

**Treatment.**—Inasmuch as intestinal toxemia and malnutrition are apparently important agencies in causing the phenomena, attention directed to the intestinal canal and nutrition is indicated. The child should be given 2 drams of castor oil, and milk should be excluded from the diet for a day or two until the stools become normal. This treatment alone has cleared up some cases. Hess has recommended the administration of 3 per cent. calcium chlorid following a starvation period of thirty-six to forty-eight hours, then the giving of the chlorid or bromid over a long period. When the spasm persists, calcium bromid appears to be of some service in controlling the symptoms in 5- or 10-grain doses four times daily. Ten-grain doses of the chlorid may be substituted.

Experiments show that when calcium is administered through the alimentary tract the calcium content of the serum is definitely increased, although it may not return to normal. No unpleasant effect has been observed from the use of the drug.

In one case there was decided retention of sodium chlorid. This was relieved by free catharsis and the use of urea, 15 grains daily in the food. The child recovered in two weeks.

The patient should be kept very quiet during an attack, as undue excitement may precipitate an attack of laryngismus stridulus or convulsions, which may be of a very serious nature. A warm bath at 105° to 110° F. for a few moments, repeated at six-hour intervals, will often have the desired relaxing effect.

The later treatment consists in regulating the child's nutrition. If the malnutrition is extreme, or if the infant is under six months of age, a wet-nurse affords the safest means of nutrition. A wet-nurse, however, is not practicable for children over one year of age. There is, moreover, considerable uncertainty as to how older infants approaching the twelfth month will take the breast. When employment of the wet-nurse is impossible or impracticable, an adjustment of the food to the child's digestive capacity is demanded along the lines laid down in the section on Malnutrition (p. 112).

*Diet.*—Not a few of the infants who develop tetany have had food poor in protein, such as is furnished by the proprietary foods and condensed milk, or they may have had a low protein capacity, which, as far as the nutrition is concerned, amounts to practically the same thing. The protein elements in the diet, therefore, should be kept well in mind in feeding these cases. It is in such cases that peptonized milk and malt soup (pp. 76 and 78) are indicated. The milk should always be given raw unless the patient's station in life or the season of the year forbids. If the milk is heated, as is necessary in malt-soup feeding, orange- or beef-juice should be given at the same time.

*Climate.*—When possible, children who have had tetany should in every instance be given the advantages furnished by climate. An outdoor life in the country abounding in sunshine, with open windows at night, is necessary for rapid repair of the weakened physical condition which underlies the disorder.

*Bath and Oil Inunctions.*—The patient should be given a brine bath (p. 843) at bedtime. This is to be followed by inunction with an animal fat during the cooler months, goose-oil or fresh lard being preferred.

*Tonics.*—As these patients are usually suffering from a secondary anemia, 1 to 2 grains of citrate of iron and ammonium may be given two or three times daily after feeding. The hygienic and dietetic management of tetany is practically the same as that suggested for marasmus and malnutrition.

Because of its established effect in promoting calcium retention and its specificity in the prevention and cure of the closely allied disorder, rickets, *cod-liver oil* should be administered routinely in the treatment of tetany.

## INSANITY IN CHILDREN

Insanity in children, implying a completely developed functional mental disorder, is very infrequent. When it occurs, its existence may most frequently be traced to hereditary influence. This need not imply the existence of actual insanity in the patient's ancestors, but, in many instances, only pronounced neuropathic diathesis, the effects of which are apparent under conditions of excitement and stress. In certain families there may be a gradual deterioration of the character described by Kirchoff: "In the first generation we find, apart from nervous symptoms, the disappearance of ethical feelings; then follows a generation in which the tendency to excesses appears, and the danger is then greatly increased by alcoholism. In the third generation there is perhaps suicide, or an affective form of insanity, and finally more profound mental disorders appear, such as congenital idiocy."

Probably no less important than heredity are the environment and the early associations of the patient. A child's mental processes are closely dependent on sensory impressions and the affections of pleasure and pain. Desires are inherent, but active volition and self-control are faculties of slow development. Imagination, as pointed out by Dr. Olga Bridgman,<sup>1</sup> is such an important faculty that percepts and images at times become confused, this fact accounting for much misunderstood lying on the part of young children.

Under these conditions phenomena, such as fright, illness, injury, or neglect, exert a greatly augmented influence. The period of puberty, moreover, is responsible for perversions, emotional outbreaks, and other manifestations of instability, which explain the origin of a large group of cases of mental aberration.

Thus, in any individual of neurotic temperament subjected to bodily suffering, overwork, or mental strain during the period of growth, insanity may occur, and its relative infrequency can be explained only by the remarkable recuperative possibilities of this period.

**Imperative Concepts; Morbid Fears.**—These constitute the simplest psychic disorders of childhood, and are extremely common and of great diversity, ranging from simple incapacity to resist the fascination of deep water and high places, to uncontrollable fears of darkness or open places and crowds (*agoraphobia*) or lightning and storms (*astraphobia*). Occasionally the child may become overwhelmed by some impulse too great for him to resist, and develop a definite "craze." The most common forms of this are *kleptomania*, *pyromania*, and *dromomania*. Of these, the "running away" impulse is perhaps oftenest recognized as something for which the subject is not fully responsible.

**Neurasthenia** is much less common in children than in adults, but may develop in children of neurotic ancestry amid any conditions which produce mental or bodily fatigue. Too long school periods, excessive social demands at home, and late hours are among the most common causes especially affecting poorly developed children. The usual symptoms of chronic irritability, sleeplessness, and "moods" may give way at last to a state of true hypochondriasis.

<sup>1</sup> Psychology of the Normal Child, Jour. Amer. Med. Assoc., vol. 81, No. 15, 1923, p. 1260.

**Hysteria** in its more pronounced forms should be distinguished from mere laughing and crying spells, which children frequently exhibit without complete loss of control. Nevertheless, "in all hysterical subjects," according to Sachs, there is "not so much a direct lack of power to exert the will as a tendency to exert it in perverse fashion." Occasionally, after a period of severe stress, a child may develop hysterical mania. This occurs occasionally in girls on the establishment of menstruation. In cases of true hysteria, sensory and motor disturbances are common, and occasionally hystero-epileptic attacks may occur.

This subject is considered more specifically under a separate caption, p. 524.

**Melancholia** is frequent in children, and may assume a serious form, characterized by the development of suicidal tendencies. In most instances, however, the prognosis for recovery is good.

**Mania** unrelated to hysteria may be induced by great excitement, fright, or febrile diseases. The influence of puberty upon the development of the condition in girls has been noted. Under symptomatic measures involving enforced rest and quiet, maniacal cases in the young usually terminate in recovery after a few months.

**Dementia præcox**, though not a disease of childhood, is common after the twelfth year. Hebephrenic, katatonic, and paranoid types are described. The frequency of a prodromal period marked only by neurasthenia and hypochondriasis should be remembered.

**Treatment.**—The treatment of the psychic disorders of childhood is comparatively simple. Under a firm but quiet home régime, with proper attention to existing physical defects, the milder cases of derangement ordinarily respond favorably. Punishment for the persistence of ideas and fears for which the patient is not directly accountable may do great harm. Hysterical symptoms of considerable duration may, however, yield readily to the right sort of sensory or psychic "surprise." Suggestion has a very wide field in the treatment of children.

In the more severe forms of mania, isolation, close supervision, rest, and hydrotherapy afford good results.

A properly functioning digestive tract and a good supply of hemoglobin and red corpuscles are essential to the preservation of a normal mentality in any child, regardless of heredity or environment.

## MALFORMATIONS OF THE BRAIN AND CORD

The various types of cerebral malformation are of developmental rather than of clinical interest.

**Meningocele**, **encephalocele**, and **hydrencephalocele** are protrusions of cranial contents through congenital gaps which persist between the bones of the skull. Such defects are most common in the occipital and frontonasal regions.

When the protruding sac consists only of the membranes surrounding the brain, it is called a *meningocele*; when a portion of the brain itself is included, the tumor is called an *encephalocele*; and when the encephalocele contains ventricular fluid, a *hydrencephalocele*.

**Porencephalus** is a condition characterized by the existence of a

hole in the brain substance. This abnormality may be congenital or acquired. The congenital form may develop from a traumatic encephalitis during intra-uterine life. The acquired form is usually due to meningeal hemorrhage. The cavity in porencephalus commonly involves the motor areas of the cerebrum and extends into the lateral ventricle. According to Dana, true porencephalus due to a congenital defect in nutrition occurs in about one-fourth the cases of cerebral palsies in children.

**Cyclops, hemicephalus, anencephalus, and malformations of individual lobes of the brain** belong to the domain of embryology and



Fig. 97.—Meningocele.

neurology, rather than to general pediatrics. The terms themselves roughly define the respective conditions.

### HYDROCEPHALUS

By hydrocephalus is understood an excessive amount of fluid within the skull. This fluid may be either within the brain, in the ventricles (internal hydrocephalus), or it may be external, existing as an effusion into the subarachnoid space (external hydrocephalus). Further differentiation is made into the acute and chronic, congenital and acquired, types. A fault in our nomenclature is that there is too much of it. It is a question whether a differentiation into the acute and acquired types is possible, for no one can state that in the cases which develop late—the so-called acquired cases—there was not an excessive fluid content at birth. In fact, acquired internal hydrocephalus is an exceedingly rare condition. When it occurs it is usually the result of some mechanical venous obstruction. It is most common in cases of meningitis, due to inflammatory material closing the foramen of Magendie. The aqueduct of Sylvius may also be occluded.

According to Sachs<sup>1</sup> the most common form of obstruction is that due

<sup>1</sup> Nervous Diseases of Children.

to tumor in the posterior fossa. Through such obstruction the foramen of Magendie may become occluded, and dilatation of the third ventricle result. Inflammatory processes may cause a closure of the communicating channels between the ventricles and cause a hydrocephalus. The amount of fluid in the acquired cases is usually small.

*Congenital Hydrocephalus.*—An excessive accumulation of fluid develops in the cranial cavities during intra-uterine life, which has been attributed to many causes, among which syphilis and alcoholism are frequently mentioned. Our own experience is in accord with that of many other observers, in that no satisfactory explanation for the condition has been obtained.

Congenital hydrocephalus is essentially chronic. It is an internal hydrocephalus, that form of the disease which is usually seen, and the condition referred to when the term "hydrocephalus" is used without qualification. The head may reach an enormous size. Holt reported a case in which 5 pints of fluid were found at the autopsy. In one of our cases there were 3 pints. The usual amount is from  $\frac{1}{2}$  to 2 pints.

The fluid is clear, and contains the chlorid of potassium and sodium, cholesterin, a trace of albumin, and sometimes urea. As a result of the pressure exerted, the brain substance becomes thinned to a mere shell. The convolutions are entirely obliterated. Removal intact of what is left of the brain may be impossible after the withdrawal of the fluid, owing to the fact that what remains of the brain tissue falls together in a broken mass.

The ependyma may be normal or thickened and infiltrated.

*Chronic external hydrocephalus* is of rare occurrence. When present it will be found associated in nearly all cases with a pachymeningitis. The congenital form of external hydrocephalus is exceedingly rare. Very few authentic cases have been reported.

*Internal hydrocephalus (acute)* is of infectious origin. Any of the pathogenic bacteria may be operative, and the symptoms that are presented are those of pressure, seen in the various forms of meningitis.

The subject of hydrocephalus has received much investigation in recent years, notably through the studies of Dandy and Blackfan.<sup>1</sup>

Two groups of cases were differentiated by the terms *obstructive hydrocephalus* and *communicating hydrocephalus*. In the obstructive type neutral phenolphthalein solution introduced into the ventricles failed to appear in the spinal fluid; in the communicating type the dye appeared promptly in the spinal fluid. The obstruction when demonstrated at autopsy was found to consist of a malformation, inflammatory process or tumor, usually at the Sylvian aqueduct or the foramina of Luschka and Magendie. In such cases the hydrocephalus is due to failure of the fluid formed in the ventricles to pass into the subarachnoid space where alone its absorption occurs.

In the communicating type adhesions at the base of the brain prevent the cerebrospinal fluid from reaching the cerebral subarachnoid space where a large part of the normal absorption occurs. This type of hydrocephalus is probably always due to meningitis which may have been unrecognized.

<sup>1</sup> Amer. Jour. Dis. of Child., 1914, 8406; 1917, 14,424.

The occurrence of hydrocephalus following operation upon meningocele is ascribed to the removal of a considerable portion of absorbing area.

**Symptoms.**—In a case of the usual type—the congenital—which develops into chronic hydrocephalus, it is noticed at birth that the child's head is large. During the following week it is apparent that the head is increasing out of proportion to the remainder of the body. The skull enlarges symmetrically out of proportion to the face (Fig. 98), with bulging of the fontanel and separation of the sutures. The blue veins of the scalp become enlarged and prominently outlined in the pale skin. The head may reach an enormous size. In one of our cases the circum-



Fig. 98.—Chronic internal hydrocephalus.

ference was  $27\frac{1}{2}$  inches at the time of death—the nineteenth month. The infant in advanced cases is not able to hold up the head, is dull and stupid, cries when disturbed, and takes food with indifference. The facial aspect is characteristic—triangular, pinched, and pale. The eyes take on a peculiar stare and are directed downward, showing considerable paling of the sclera above, and never below. There is usually convergent strabismus, and there may be nystagmus, the latter occurring in quite a number of cases.

Malnutrition is always present. Dentition is delayed. The hair is scanty and coarse. Resistance is of a very low order.

Nervous manifestations, exhibited in the extremities, are not necessarily present. Some patients will show a moderate degree of spastic

muscular contraction. The hands may be clinched and the feet extended. In others no nervous manifestations whatever will be referable to the extremities.

**Duration.**—The child rarely lives to the twelfth month. Intercurrent disease, usually bronchopneumonia or an intestinal infection, terminates the case.

The above is a description of hydrocephalus as usually encountered. The course and outcome, however, are not always the same. The process may be arrested at any time. We have seen a few such cases. The enlargement of the cranium in these patients is slower, and noticeable enlargement may not occur until the fifth or sixth month is reached.

*Illustrative Cases.*—A female private patient had suffered from digestive disturbance and moderate malnutrition in the early months. She improved satisfactorily, so that an interval of six weeks elapsed without medical observation. When she was five months old the writer had occasion to readjust her food, and was astounded to note the change in the size of the child's head. It showed the characteristic globular form, the high forehead, and large fontanel, but there was no separation of the sutures. The circumference was 17 inches. Squint or nystagmus was not present, and the child supported the head well. During the next two months the head increased in size 3 inches. It remained at 20 inches for four months. The child at six years of age was normal in all respects.

Another female patient first came when she was one year old. The mother thought that the head had been growing out of proportion to the body for a few months. The growth continued until the child was two years old, at which time the circumference of the head was 22 inches. The patient was last seen when six years of age. The mother considered the child mentally normal, although we were not convinced that such was the case.

Cases such as the foregoing are those which are reported from time to time as cured by various methods of treatment. Further, they might be looked upon as belonging to the so-called acquired type. Such cases demonstrate that there may be a hydrocephalic process quite active in character which subsides of its own accord, as no treatment was given these patients except proper food and suitable general care.

Many authors maintain that cured hydrocephalus is not at all unusual. According to Sachs, the protruding occipital bone, clearly visible on so many bald heads, points to a moderate amount of internal hydrocephalus in the early years of life.

**Prognosis.**—The prognosis is decidedly unfavorable in those cases in which the hydrocephalus is present at birth. Practically all such patients die before the tenth month. Occasionally one will live to be over one year old. In the cases of slower or possibly later development there is a possibility of spontaneous cure.

**Diagnosis.**—The diagnosis is not difficult. There is an enlargement of the cranium, which is fairly evenly distended in all directions. The fontanel is enlarged and pulsating, and the sutures are widened.

The rachitic and the hydrocephalic head are frequently confused. In hydrocephalus the veins of the scalp are distended, and nystagmus and squint are present. Early in the case, if doubt is felt as to the nature of the trouble, weekly measurements of the skull (see p. 36) will determine whether or not there is an excessive growth.

**Treatment.**—Until very recently no medical treatment has proved of any curative value in hydrocephalus. Favorable results, however, have

been attained by Marriott, of St. Louis, to whom we are indebted for the following report:

"In the medical treatment of hydrocephalus the object to be attained is an increased absorption or a diminished secretion of cerebrospinal fluid. It has been observed that when the surface tension of the blood is raised there is a tendency for fluids to pass from intercellular spaces and serous cavities into the blood-vessels. One of the most effective means of raising the surface tension of the blood is the administration of theobromin sodium salicylate (diuretin) by mouth. In a series of patients we have been able to definitely influence the course of hydrocephalus by oral administration of diuretin.

"Favorable results are to be expected only in those cases in which there is free communication between the ventricles and the subarachnoid space. The dosage of diuretin for an infant is from 0.1 to 0.3 gm. three or four times a day. The dosage depends upon the rate at which the head is increasing. When sufficient diuretin is given to a patient with the communicating type of hydrocephalus, there is usually complete cessation of the growth of the head. When the diuretin is stopped the head again begins to increase in circumference. The treatment has to be continued for a long period, but in some cases, as the child gets older, the amount of diuretin can be diminished or even completely stopped. . . . We have observed no ill effects from the long-continued use of diuretin. Infants under the treatment have gained weight and have developed in a normal manner."

Radiography of the skull after the injection of air into the ventricles has recently been employed to aid in the more accurate diagnosis of the existing anatomic conditions in various cases, and in a few instances brilliant operative results have been achieved.

### MICROCEPHALUS

In this condition (see Fig. 99) the capacity of the skull is less than normal, and the brain itself is abnormally small. This defective development has been explained by Virchow's theory of premature ossification in the cranial bones, but according to Sachs, is probably due to atrophic changes, which are the result of hemorrhage or inflammation affecting the brain and its membranes. If the latter be the true explanation of the deformity, any treatment of an operative character to allow brain expansion by increasing the dimensions of the skull must promise little.

Neither explanation is satisfactory. There is more than a premature ossification. The skull formation along the line of sutures is excessive. In many cases may be found at the line of the suture a distinct ridge, as though nature had taxed herself to the utmost to unite the cranial bones. The ductless glands possibly are a factor in the overdevelopment. With the excessive ossification at the sutures the bones of the skull generally are much thicker than normal.

**Symptomatology.**—The symptomatology is similar to that described under Cerebral Palsy. The patients are almost always low-grade defectives.

In subjects with microcephalus—microcephalic idiots—who survive

infancy, symptoms of paralysis, lack of development of the special senses, and low intelligence are the rule.

*Craniectomy.*—The operation of craniectomy, based upon the theory that the condition is due to a premature ossification of the skull, was much in vogue several years ago. It was usually unproductive of beneficial results, and has been discarded.



Fig. 99.—Microcephalic idiot.

*Illustrative Case.*—Craniectomy was performed on an imbecile boy of four years of age at the New York Infant Asylum. After the operation he received more care and attention than before, and seemed to develop somewhat along mental lines, but when the attention was later withheld he relapsed into the former condition.

## SPINA BIFIDA

Spina bifida is the term applied to a congenital cleft in the vertebral column which permits of a hernia of part of the contents of the canal. The defect is found most frequently in the cervical or lower lumbar vertebræ.

In *meningocele of the cord* the membranes alone constitute the hernial sac.

*Myelomeningocele* is a protrusion of a portion of the spinal cord and its attached nerve-roots, together with an accumulation of fluid, which usually has its origin in the anterior subarachnoid space.

In *syringomyelocele*, *hydromyelocele*, or *myelocystocele* the central canal of the cord is dilated with fluid, and the cord substance itself forms the lining of the sac.

The malformations just described are frequently accompanied by other abnormalities in the same subject, such as hydrocephalus, club-foot, sensory and trophic disturbances, and exstrophy of the bladder. With myelomeningocele and syringomyelocele paralysis of the extremities, bladder, and rectum may exist.

Diagnosis of the type of spina bifida present in a given case is not always easy.

Simple spinal meningocele is frequently found in the sacral region. This tumor is often translucent. It protrudes through a small cleft in the canal and is pedunculated. It is seldom associated with symptoms of paralysis.



Fig. 100.—Spina bifida.

In myelomeningocele and syringomyelocele the swelling is ordinarily less transparent and has a broader base. Pressure on the tumor may cause distention of the fontanel. These forms commonly occur in the lumbosacral region, but may exist in any region of the spine. Paralytic symptoms are much more common than in cases of meningocele.



Fig. 101.—Spina bifida with complicating hydrocephalus. (Bellevue Hospital.)

Of the three forms, syringomyelocele is far the most frequently associated with hydrocephalus.

**Prognosis.**—Simple meningocele offers a fair prognosis under treatment. Some cases even terminate favorably by spontaneous rupture of the sac and closure of the cleft in the spine.

In other instances operation may be followed by complete recovery,

although in about one-third of the cases the operation is followed by an acute hydrocephalus, and in other cases the control of the bladder and rectum may be permanently deficient.

In a child two months of age the beginning of hydrocephalus was apparent ten days after the removal of the meningocele.

The two other forms of spina bifida are very unpromising, and under the best therapeutic measures usually result fatally.

**Treatment.**—The results of treatment of spina bifida, regardless of its type or the method employed, will scarcely warrant us in promising parents much in the way of improvement. In our experience the injection of iodine has not been of any value. The pressure treatment is unsatisfactory. Surgery promises better results than does any other treatment. Operative measures are fully described in works on surgery, and the results are sometimes brilliant. So-called cured cases, however, often develop internal hydrocephalus, so that the latter condition is worse than the original. Operations, further, are not without immediate danger, for in a great majority of cases portions of the cord are within the sac, the excision of which may result in permanent paralysis and deformity. It is the duty of the physician to see that the tumor is carefully protected and kept clean, and that the child is properly nourished until such time as a suitable operation is thought advisable.

#### TYPE AND INCIDENCE OF BRAIN TUMOR

Tuberculous tumors are by far the most frequent form of intracranial neoplasms occurring in childhood. More than 50 per cent. of all brain growths belong to this type. Next in order of frequency are gliomata, gliosarcomata, and sarcomata, while adenomata, fibromata, angiosarcomata, cholesteomata, and gummata are all rare in children, carcinoma being exceedingly rare.

Cysts of the brain resulting from an old hemorrhage or from embolic softening may simulate the symptoms of a growing neoplasm if the cyst contents become suddenly increased. Parasitic cysts of the brain (*echinococcus* or *cysticercus*) are not unknown in children.

Brain tumors may be congenital, or they may develop at any time after birth. Gowers observed 18.5 per cent. in the first ten years and 14 per cent. in the second decade of life.

In general the symptoms are those referable to increased intracranial pressure combined with signs of irritation or paralysis, showing a focal distribution depending upon the site of the neoplasm.

The sole treatment of lasting value for brain tumor is operative removal. This presupposes exact diagnosis and correct localization of the growth. In an exhaustive review of treatment of brain tumors Dandy<sup>1</sup> has made the following statement with reference to operative procedure of a less thorough character:

"Decompressions, routinely performed, are among the most harmful and indefensible operations in surgery. They should never be performed for unlocalizable tumors. They are the exact equivalent of giving morphine for abdominal pain; the symptoms are masked until it is too late.

<sup>1</sup> Jour. Amer. Med. Assoc., 77, 24, December 10, 1921.

"Decompressions should be performed only as a last resort—when the tumor cannot be removed; and then only after the location of the tumor is known, for in half the cases of brain tumor no good can possibly be derived from a decompression."

### MENTAL DEFICIENCY; IMBECILITY; IDIOCY

It is not practicable, even were it possible, to make a differentiation of the various types of mentally defective children. Mongolian idiocy, cretinism, and amaurotic family idiocy are distinctive types, each type having characteristics of its own sufficient to demand a distinct classification. All other forms are so variable in their etiology and the degree of impairment which they produce that any separate grouping is impossible. Thus we see idiocy due to microcephalus (p. 554), to hydrocephalus, to antenatal defects, to birth trauma, and to meningitis, particularly of the cerebrospinal form.

Besides microcephalic, hydrocephalic, Mongolian, amaurotic family, and cretinoid idiocy, there is a form of idiocy in which the brain shows sclerotic areas in the cortex. These may be due to hemorrhage at birth. Cerebrospinal meningitis complicated by encephalitis may also be responsible for the sclerosis. Finally, there may be porencephalus, a smaller or larger defect in a cerebral hemisphere, either of congenital origin or due to hemorrhage at birth or later.

**Unclassified Cases.**—The brain, although a most important organ, is very ineffectively protected until the child is well on in the third year. If the facts in each case were known, it would probably be discovered that brain trauma at birth was the cause of idiocy in a large majority of the unclassified cases. Syphilis, consanguineous marriages, and alcoholism are looked upon as etiologic factors by many authors. The mental impairment varies within wide limits, and the cases range from those of complete idiocy to those in which it is impossible to determine whether the patient is within or without the group which is looked upon as normal. Mental impairment is often associated with spastic paralysis; the majority of the unclassified cases show such association. Nevertheless, in the examination of hundreds of cases in institutions, many defectives will be found in whom there is no evidence of muscle involvement. Occasionally the mental impairment is linked with progressive optic atrophy independent of amaurotic idiocy.

Epilepsy in early life tends to mental impairment, and may eventually result in idiocy. Cases are frequent in which no cause whatsoever can be demonstrated to explain the condition.

Mentally defective children are described as backward, feeble-minded, children of retarded development, imbeciles, and idiots. In a legal sense all are imbeciles who cannot appreciate right and wrong. Idiots show complete absence of responsibility.

Defective sight and hearing may place a child, naturally not mentally keen, in the defective class.

Among the children often classified as defective are unquestionably those who are simply *retarded* in their mental development, and for these much may be accomplished. Not every normal child's mental development corresponds to his physical growth. We see precocious children of

eighteen months who are equal in mind to the average child of three years, and others three years of age who have a mental development of the normal child of eighteen months. This difference in relation between the mental and physical age may continue well into adolescence. It is therefore a mistake to draw the defining lines of intelligence too hard and fast.

Unquestionably, on the other hand, there are fundamentally stupid, mentally slow children who are to be regarded as perhaps having poor endocrine capacity, particularly inherent in the thyroid. Such deficiency, beyond the slightest doubt, will in the future be shown to play a much larger part than is demonstrable at the present time. Only a proportion of all children with thyroid dysfunction are cretins. There are lesser degrees of dysfunction, and in some children the endocrine system as a whole appears to be slower in manifesting its powers than in others. The writer has repeatedly known children who were far behind their fellows in mental capacity grow into capable young men and women far more clever in their chosen fields of work than others who showed a very early development. It has accordingly long been his custom to give the benefit of the doubt to such slow children and advise a course of endocrine therapy. In such instances a very small dosage of thyroid has been employed, perhaps only 1/10 to 1/20 grain a day.

There is not much difficulty in differentiating the actually defective from the slow. The former show traits that are fairly characteristic and reactions to their surroundings which are out of tune and out of time as regards the age.

Capacity for purely physical activity in such children is greatly retarded.<sup>1</sup> They are very slow in holding the head erect. They walk late, fail to observe normally, and wear a blank expression. As they grow older the mentally defective further prove their deficiency by behavior that is perverse and foreign to the instincts of a normal child. They are often personally unclean and have no sense of pride; they fail to appreciate discipline, and may be wantonly cruel and destroy with apparent pleasure. Speech is usually defective and drooling is common. The vacancy of the facial expression is carried on from babyhood. The facial expression alone, however, is not to be relied upon in diagnosis, as many badly defective children look astonishingly bright.

Much may be learned of the child's mentality by the nature of the amusement selected. A child of four whose chief entertainment is to tear up paper is mentally defective. Likewise is the one who delights to sit and rock his body and stare into space. Pyromaniacs, several of whom the writer has had to treat, belong to this class. Finally, an invariable characteristic of the mentally defective child is inability to concentrate. He rushes from one amusement to another and handles one object after another. If he is interested in anything for a considerable period of time it is the thing to which the normal child would not be attracted.

**Treatment.**—(See p. 562.)

<sup>1</sup> Refer to *Mental and Physical Development in the Infant*, p. 38.

## MONGOLIAN IDIOCY

The Mongolian type (Figs. 102-104), is found with very few exceptions only in the Caucasian race, and received its designation because of the facial resemblance of the subjects to the Mongolian.



Fig. 102.—Mongolian idiocy.

**Etiology.**—Mongolism is of congenital origin. There is no known cause. Debility in parents seems to play an important part. Children of this type are often found among the last born of old parents, representing the fifth, sixth, or seventh pregnancy. This, however, is unusual. In this condition, as in cretinism, it will possibly be discovered in the future that we are dealing with a ductless gland defection. Whatever may be the cause, it is identical in all, for all Mongols are alike in form, feature, intelligence, and the many characteristics that go to form the symptom complex of Mongolism; this regardless of race, social position, age, or

physical condition of the parents. Whatever may be the basic error, it is the same in all and it is not due to syphilis.

**Pathology.**—Besides the Mongolian type of face, the microcephalic skull and the retarded bone growth are characteristic of the disease.



Fig. 103.—Mongolian defective. (Bellevue Hospital.)

Mongolian idiots at autopsy show the evidence of faulty development of the brain cortex. The entire brain is smaller and lighter in weight than is normal, and fissuration is defective. Congenital cardiac malformation is not infrequent in these cases, patent ductus arteriosus and

an incomplete ventricular septum being the commonest lesions found. Other visceral malformations occur less frequently, but stigmata of degeneration are very numerous, especially of the palate, ears, and fingers.

**Symptomatology.**—The face is usually defective in expression, broad and flat, the nose small and broad at the base, the eyes wider apart than in the normal child. In rare cases the face, which is usually round and full, will give the impression of a considerable degree of intelligence (Fig. 102). The eyes are prominent and placed obliquely, with the palpebral fissures extending in an upward direction, elevating the outer canthus. The skull shows anteroposterior narrowing, which, together with the prominence of the upper cervical vertebra, causes a marked narrowing of the nasopharyngeal vault. This is readily appreciated on examining the subject for adenoids, which are often suspected because of the habit of the open mouth and mouth breathing. The tongue is usually large, and protrudes during a greater part of the time. The muscles of the arms and legs are soft, the skin is usually rather dry and bluish, and



Fig. 104.—Mongolian idiot (five months) showing advanced malnutrition.

there is a tendency to coldness of the extremities. The joints are relaxed and the ears are crumpled. There is a distinct inward curve of the little fingers, particularly of the third phalanx. The occiput is flat. The children have a vacant, stupid expression, and are unusually good-natured. They cry much less than normal children. They are feeble, and particularly subject to respiratory and intestinal infections. A great majority die before they are three years of age. A few grow to adult life. In an institution for the feeble-minded there were but two Mongols among 300 inmates, all over eight years of age. We recall several distinct Mongols who possessed a fair degree of intelligence. Such instances, however, are very exceptional. Development is generally delayed, the teeth appear late, and what speech ability is attained is acquired only after the child is four or five years of age.

**Diagnosis.**—It is difficult to understand why so many of these cases fail of diagnosis. The patients are not at all like normal children and may only be confused with *cretins*. (For differential diagnosis see *Cretinism*, p. 466.)

**Treatment of the Mentally Defective.** The mental defectives, with the exception of the cretin, the amaurotic family idiot, and the spastic paralytic, lend themselves to one scheme or method of treatment, which is to be considered from two standpoints: first, that of attention to the physical condition; second, that of attention to the mental condition. Under the first heading are included the correction of deformities and the management as relates to hygiene and nutrition. The second consideration, relating to the mental aspect of the case, concerns not only the patient but the immediate interests of the family.

*Institutions.*—Almost without exception the place for a mentally defective child is in an institution which is devoted to the care and teaching of such children. The defective should be placed where much will not be expected, where he will be associated with others of his kind, where his work and his play will be adjusted and presided over by educated men and women who have made such conditions the study of their lives. The defective has his rights. He has a right to live out his unfortunate life in as pleasant a manner as possible, and this is better accomplished in an institution than in any individual home. In an institution, among other things, such patients are taught, according to their capacity, useful occupations. Not a few thus taught become self-supporting. At rare intervals one is found who possesses remarkable mental traits along certain lines, traits which the average normal individual is incapable of understanding. Patients showing a moderate degree of infirmity often become skilled in handicraft. They execute mechanically with surprising accuracy. There have been great geniuses of the past who in some respects were not considered mentally normal by their contemporaries. It is impossible to form even a fair estimate as to how the mentally defective child will develop, with age, and suitable instruction from those who are best able to discover his possibilities.

Placing these children in public institutions is often strenuously objected to on sentimental grounds by the poorer members of society because of their fears and prejudices against such institutions. In consequence, many a child is kept at home, greatly to his detriment and to the decided injury of other children in the family. Time and again we have pleaded with the mothers and fathers of such children without avail. Few villages throughout the country do not have an idiot or an idiotic epileptic for school-boys to taunt and for school-girls to fear. Most pitiable objects are these human derelicts, with whom the state does not interfere because they are "harmless." Sooner or later, if he lives, the idiot of poor parentage will become a public charge, and the better his condition at the time, the happier he will be.

Parents of means and intelligence will usually place such a child in one of the many private institutions that are conducted for the care of defectives; yet the objection will often be raised, even by these parents, that such children have so little mentality that teaching is useless. This may be true, but on this very account, if for no other reason, the child should be removed from the home because of his invariably pernicious influence on other members of the family.

The vicious, the unclean, and those showing marked moral degeneracy should be placed in institutions as soon after the fourth year as

possible. If they are to be a public charge, they should be removed from the home as soon as they arrive at the age limit which the rules of the institution require for admission. A patient who is tractable may remain at home until the sixth or seventh year, particularly if there are no other children in the family. If there are in the family younger children, whose natural tendencies and powers of imitation are always strong, the defective child should be removed as early as possible.

AMAUROTIC FAMILY IDIOCY

Amaurotic family idiocy is the name given by Sachs,<sup>1</sup> of New York, to a very peculiar disease of infancy, first described by Warren Tay in 1881. It is characterized by an impairment of the muscle functions,



Fig. 105.—Amaurotic idiocy. (Early stage.)

volitional movements being at first difficult and later impossible, the changes being of a progressive type. Defective vision and mental dullness appearing in a normal child are among the early signs. The disease progresses to complete idiocy and blindness. (See Figs. 105 and 106.)



Fig. 106.—Amaurotic idiocy. Same case. (Late stage.)

**Etiology.**—The etiology of this form of idiocy is unknown. It occurs almost exclusively in Hebrews. Different children in the same family may be affected. The disease, together with many others the origin of

<sup>1</sup> Nervous Disorders of Children.

which is not understood, has been attributed to syphilis and alcohol. The pathologic findings prove the disease to be due to a toxemia which slowly but persistently attacks and entirely destroys, through degenerative processes, whatever is vital in the entire nervous system.

**Pathology.**—Consistency is again shown in the lesions of the disease, which, wherever present, are invariably the same.

Hirsch's early findings have been corroborated by many others, showing that there is a degeneration of the ganglion cells throughout the entire nervous system. If we are to believe these investigations, there is not a normal cell left either in the cortex or the gray matter of the cord.

The cell protoplasm undergoes degeneration, the nucleus is demonstrable with difficulty and becomes a part of the degenerated cell. Later changes cause an entire loss of cell structure and render it difficult to determine the cell contour.

The ganglion-cells of the retina and the fibers of the optic nerves and tracts are degenerated, this fact accounting for the blindness. Degeneration of the white fibers of the anterior and lateral pyramidal tract has been described by Shaffer. Sachs is of the opinion that these are secondary changes.

The thoracic and abdominal viscera show no specific lesions.

**Symptoms.**—The history is usually that of a child born well and who remained in a normal condition until he was five or six, or perhaps nine, months old. He then became inactive, listless, and failed to follow objects or persons with the eyes. In all probability the sight is impaired much earlier than is supposed, as in the cases which we have had the opportunity to examine blindness was present early in the disease, and a marked degree of visual impairment as well as mental apathy will pass unobserved in many of the homes of the class who supply the amaurotic idiot. The eyes assume a peculiar fixed stare fairly early in the disease not unlike that of the later stage of meningitis. The child not only shows apathy and indifference, but is soon unable to sit up or support the head, which falls in any direction in response to the force of gravity. As the case progresses the patient loses all power—even the power of changing the position of a limb. With the mental, visual, and muscle impairment there is invariably progressive emaciation. Convulsions and nystagmus may be present, but are not characteristic symptoms.

Fairly early in the disease there is an unusual susceptibility to sound; clapping the hands or any inconsiderable noise causes the child to start violently. The reflexes alter at different periods and are variable and unreliable. Toward the end the respiration becomes very superficial, swallowing is impossible, and the child must be fed by gavage. When death occurs, the subject presents the picture of marked inanition.

**Course and Prognosis.**—The onset of the disease is very gradual. Its course is slow, with the evidence of progressive degeneration. The outcome is invariably fatal. A not uninteresting feature of the cases is their similarity. They occur in the same race of people. The onset, course, and termination are alike, even to the time required for the disease to run its course. There is almost a mathematical succession of events.

**Diagnosis.**—The disease is sometimes mistaken for meningitis. Other cases have been mistaken for those of birth-palsy. Even if there should be occasion for confusion because of the similarity of symptoms, which is very slight, the examination of the eye-grounds, which should be undertaken in every case in which there is a suspicion of cerebral involvement, renders the differentiation possible through the presence or absence of "symmetric changes in the region of the yellow spot in each eye of an infant" (Tay). This lesion Tay and Kingdon have designated as the *cherry red spot*. The presence of this sign makes the diagnosis in a suspected case positive, proving the presence of optic nerve atrophy.

**Treatment** is of no avail. Our best efforts for these patients are to be exerted in maintaining nutrition and in ministering to their comfort.

### CEREBRAL PALSIES

Three forms of this affection are recognized—the *prenatal*, the *birth*, and the *postnatal* or *acquired* palsies.

#### THE PRENATAL AND BIRTH FORMS

**Etiology.**—Concerning the etiology of the prenatal cases considerable confusion and varying opinions exist. Degeneracy of the parents, alcoholism, syphilis, and trauma are supposed to be contributory causes. We have seen a large number of undoubted prenatal cases, and are unable to add anything from the etiologic standpoint. In several instances the patients have belonged to families in which there were several other children, all normal, with nothing worthy of note in the family history, and a record of a normal, uneventful pregnancy preceding the birth of the patient.

Trauma at birth, due to the use of forceps, compression of the head in a prolonged or abnormal delivery, or perhaps excessive uterine contractions induced prematurely in some cases by the use of pituitrin, may result in meningeal hemorrhages, causing cerebral palsy. An immense number of cases are thus caused. The obstetrician should always keep in mind that with him rests the possibility of making a hopeless invalid or an idiot of the child he is about to deliver. It is fully appreciated that under unusual conditions in obstetric practice certain risks of head injury must be taken for the sake of the immediate demands of the mother or the child, but the large number of cases of cerebral palsy and idiocy which we have seen have impressed upon us the necessity of treating the child's head during delivery with the utmost care.

**Lesions.**—The prenatal and birth palsies are often paraplegias or diplegias, and as such show a great variety of lesions.

In the prenatal cases there is often failure of development of an entire hemisphere or a portion thereof. Cysts are sometimes found at autopsy. In other cases there is no change visible to the naked eye. Microscopic examination of the brain tissue shows a lack of development of the cells in the motor areas. In the cases due to trauma at birth the results of the early hemorrhage will be found. The most usual changes are sclerosis and atrophy.

In general, the lesions of cerebral palsy include meningeal and cere-

bral hemorrhages, thrombosis and embolism, meningitis and encephalitis, direct injury, tumors, atrophy, sclerosis, and cyst formation.

Atrophy, sclerosis, and cysts are the conditions most frequently observed at autopsies. Such changes are apparently secondary and may generally be ascribed to previous embolism, thrombosis, hemorrhage, or encephalitis.

Meningeal hemorrhage is much more common than hemorrhage from a cerebral vessel. Endarteritis and pachymeningitis are predisposing causes, and direct trauma and the local congestion incident to convulsions or spasms of coughing are exciting causes of such hemorrhage.

Thrombosis and embolism are rare in children, but may occur. Thrombosis is sometimes found in cases of marasmus, and in other instances may be ascribed to syphilitic endarteritis. Emboli are, as a rule, of cardiac origin, and lodge in a branch of the middle cerebral artery. Embolism may occur in the course of acute infectious fevers.

Encephalitis may result from an acute infection or from trauma. Acute polio-encephalitis as a cause of palsy is well recognized.

According to Cautley, three-fourths of the cases of acquired cerebral paralysis in children develop before the fourth year.

Sachs has stated that, prior to autopsy in a case of acute cerebral palsy of several years'

Fig. 107.—Congenital spastic paralysis. Little's disease. (Bellevue Hospital.)

duration, it is impossible to predict what type of secondary brain lesion will be found. When the symptoms have been well defined and focal, and associated with little idiocy, he had in several instances correctly diagnosed the presence of cysts. Idiocy and epilepsy associated with cerebral palsy are symptoms which he has attributed chiefly to sclerosis.

**Symptoms.**—In the first days of life stupor and failure of the infant to nurse are especially significant.

Hemiplegia is rare except in the acquired cases. In the prenatal cases, and those of hemorrhage at birth, which latter constitute by far the majority, there is frequently a diplegia or paraplegia, "Little's disease." The first symptom of trouble in these cases is usually that of spasticity or rigidity of the extremities, with a decided restriction in motion. There may be rigidity of the neck muscles. The children are often "head-borers."



One extremity may show much more involvement than the other. Spasticity and lead-pipe rigidity characterize the condition of the muscles. The reflexes are usually exaggerated. Owing to the persistent spasticity, the patient may be unable to walk or use the hands. If walking is accomplished, it is learned much later than is normal. Often walking is interfered with because of spasm of the adductors, which produces a cross-legged attitude. In those cases in which walking is finally accomplished the patient is very awkward and falls frequently. In a state institution for defectives 70 out of 300 inmates, ranging from eight years to over forty, had never walked.

The *physical development* is always of an inferior order in cases even moderately severe. The ability to hold the head erect is accomplished very late. We have repeatedly observed patients who could never support the head or sit erect. Deafness and blindness are not at all unusual. Nystagmus and strabismus are frequently seen. Speech is apt to be acquired late and may be very defective. The ability to swallow solid food is often much delayed. Even the swallowing of fluid can be accomplished only in a certain position.

*Illustrative Case.*—A child who was observed for several years could swallow fluids only when resting on his back. The impairment continued during the six years of life of the child.

The physical impairment varies widely in degree from what appears as simple awkwardness to complete inability to perform a single volitional act. The legs usually show much greater involvement than the arms. A child who has little or no use of the legs may be able to use the arms to good effect.

Many of these unfortunates die during the earlier years. Their resistance to infection is of a low order. Convulsions may occur, but have not been of frequent occurrence in our cases.

*Mentality.*—The mental capacity is also of wide variation. We have had under care several patients with normal mentality. Two, through gymnastic exercises and training, became able to perform all volitional acts and have been looked upon as normal children. There is still a slight impairment in gait, and they are known among their fellows as "clumsy" boys. The other two, girls, possess unusually bright minds, but are pronounced diplegics. One at fourteen years of age had never walked without support, the other at six years could walk alone, but with much difficulty. The gait remained decidedly spastic. She had had daily treatment since two years of age. On the other hand, we see several patients every year whose mentality is of a very low order.

Between these two extremes there are all degrees of mental impairment. Not infrequently these defective children possess decided brilliancy along a certain line, while the mind is a complete blank in other respects. Defectives often learn to accomplish purely mechanical acts very well indeed. They may become intense specialists. A defective boy developed into an expert carver of wood. Two very clever musicians were defective in every other respect.

*Epilepsy.*—Authors claim that epilepsy is present in a considerable proportion of defectives. Such has not been our experience. In fact, in children of this type epilepsy has seemed exceptional.

## THE ACQUIRED FORM

Hemiplegia may be said to characterize the acquired cases, and while diplegia and paraplegia may occur, this is the exception.

**Etiology.**—Our cases have all been the result of infection, stress, or direct trauma; or have been due to spontaneous hemorrhage neonatorum. (Cf. Rhodda's findings, p. 184.)

A comparatively trifling injury is sometimes sufficient to produce a hemorrhage.

*Illustrative Cases.*—A boy twelve years of age, a pronounced hemiplegic with normal mentality, owes his present condition to a fall from his baby carriage to the ground when nine months of age. The fall was followed by repeated convulsions and hemiplegia. He came under treatment a few days after the fall. The lesion was located, the skull trephined, the blood-clot removed, and the bleeding vessel ligated. The boy today walks well with a brace; the arm will probably never be of much service.

Another child, fourteen months of age, was perfectly normal previous to an acute attack of indigestion with high fever and convulsions. The seizures were repeated several times during the day. After the third convulsion it was noticed that there was complete paralysis of the left side of the face and of the right arm and leg. The child died thirteen months afterward. His mentality was never clear.

A mother and her seven-month-old babe went in bathing at the seashore, the babe in the mother's arms. A ground swell engulfed them. When the child was resuscitated it was found that there was complete hemiplegia.

Another case occurred during pertussis. Hemiplegia developed after a severe paroxysm. The child lost consciousness, which was not regained; and death followed in seventy hours as a result of cerebral hemorrhage.

A child eleven months of age fell to the floor from his crib, striking on the head. Hemiplegia developed at once, followed by death in a few hours. Autopsy showed extensive cerebral hemorrhage.

Hemiplegia may be the result of congenital syphilis. The Wassermann test should always be taken in every instance in which hemiplegia develops. In hemiplegia with congenital syphilis there is usually no prodromal symptom. The paralysis is either noticed when the child wakes in the morning, or develops spontaneously during the day.

Any of the diseases of bacterial origin may cause cerebral palsy of the hemiplegic type. Infection as a cause, however, is very infrequent. (This opinion is based entirely on our own experience.) More cases probably result from cerebrospinal meningitis than from any other form of infection. The lesions in the cases reported as occurring with various infectious diseases and gastro-enteric disturbances are probably the result of the convulsions which may have ushered in the illness. A convulsion is never without danger in a child.

**Age.**—It is unusual for a case to develop after the seventh year. The majority of the cases occur before the fourth year.

**Symptoms.**—The first symptom is usually that of *paralysis* following a convulsion or recognized trauma. In some cases there is paralysis (hemiplegia) only; in others, profound mental disturbance. The duration of the paralysis depends upon the nature and extent of the injury. The paralysis, which is spastic in character, may completely disappear, or permanent disability with contractures may remain. Usually there is some impairment of power. The arm functions may be completely restored. The leg improves less rapidly, and is more apt to show permanent disability. (This is the reverse of the experience of most authors.) Not infrequently the patient develops one of the various forms of club-

foot with resulting permanent contractures and deformity, which means that certain muscle groups have been particularly involved.

The facial muscles are involved in a small proportion of the cases—perhaps 15 per cent. Complete restoration to the normal is the rule. The patellar reflex is usually exaggerated on both sides, but most markedly in the leg of the affected side. The gait may be interfered with or the function of the limb may be entirely lost. In other cases in which the focal lesion is less pronounced, walking may be accomplished after orthopedic attention.

*Electric Reaction.*—The reaction of degeneration is usually present.

*Sensation* is not permanently disturbed. Early in some cases there appears to be some impairment which, owing to the mental state of the patient, may be difficult to determine accurately.

*Disturbance of Speech.*—Aphasia is present when there is a left third frontal lobe involvement. Impairment of speech may also occur when the right hemisphere is affected, although to a lesser degree. When the speech center in the left hemisphere is involved, the right may take on the function.

*Inco-ordinate Movements.*<sup>1</sup>—Inco-ordination of the paralyzed parts, particularly of the arm, has been repeatedly observed. These non-volitional movements have been erroneously termed “choreic.”

*Illustrative Case.*—A patient two years of age had, at the age of one year, repeated and prolonged convulsions covering a period of three days. Pronounced hemiplegia resulted, with mental impairment. After one year the hemiplegia entirely disappeared, but phenomena of muscle gymnastics remained that were difficult to describe. The child rocked and swayed the body. The muscles of the right side of the face underwent frequent rapid contractions and relaxations. Voluntary muscular acts were, however, readily accomplished. Athetosis was present in a marked degree. There were rhythmic motions of the flexors and extensors of the fingers and forearm. The child's mentality was much impaired.

*Athetosis* is of more usual occurrence in cases in which the lesion has apparently been severe.

*Epilepsy* may be expected in any case of hemiplegia. Gowers found it occurred in over 60 per cent. of his cases. Sachs reported epilepsy in 50 per cent. Epilepsy may not occur until several years have elapsed. Thus, in one of our cases, the child had the injury and hemiplegia when nine months of age, and did not develop epilepsy until the tenth year.

Epilepsy, when it develops, is usually of the jacksonian type, and is often very mild in character.

*Mental Impairment.*—While mental impairment may be said to be the rule, it by no means follows that a child with hemiplegia may not be perfectly normal mentally. It would naturally be supposed that involvement early in life would be particularly likely to affect the mentality, and such is the case. Nevertheless, patients with conditions of this nature may make complete recovery and become mentally competent individuals. The intelligence may be normal, or there may be complete idiocy, or any degree of impairment between these extremes.

*Diagnosis.*—The diagnosis is not difficult. In the *prenatal and birth cases* there are early diplegia and paraplegia, with unmistakable evidence of mental impairment. The child does not smile or hold up the head or attempt to play with toys at the usual age, and is slow to recog-

nize people or surroundings, frequently also exhibiting difficulty in swallowing and inability to perform volitional acts. All these patients have a characteristic vacant expression—a meaningless stare.

In the *acquired cases* the paralysis is unilateral, with exaggerated reflexes on the involved side. Further, there is usually the history of trauma and sudden onset.

**Treatment.**—The medical treatment of the paralysis consists in maintaining a high degree of nutrition. The management, in general, in the different types of cases varies, depending upon the intelligence of the patient, the location and extent of the paralysis, and the resulting deformity. Braces are necessary in many instances to prevent contractures and deformities, as well as to aid in correcting those already present. In some cases of normal or fair mentality marked improvement has followed daily systematic manipulations and exercises under the management of an expert in this line of work.

A number of selected cases have been benefited by cerebral decompression operations recommended by Sharpe<sup>1</sup> and other advocates of the method as a procedure applicable particularly to cases showing increased spinal fluid pressure, and indicated at an early age. Our experience with cases submitted to this operation, although limited, has not been encouraging.

#### CHOREA (ST. VITUS' DANCE)

Chorea, in the form originally described by Paracelsus, is extinct. In the Middle Ages, however, a form of dancing mania was widely epidemic throughout Europe, and sketches still testify to enormous fourteenth century pilgrimages to the shrine of St. Vitus. The term *chorea* ordinarily applies to the condition described by Sydenham in 1686; and the names *chorea minor*, *chorea vulgaris*, and *chorea anglorum* are synonymous.

Under the general title, furthermore, are grouped such cases as those described by Huntington in 1872 as hereditary in type, and a large heterogeneous collection designated by such self-explanatory terms as *chronic progressive chorea*, *chronic adult chorea*, *congenital chorea*, *senile chorea*, *chorea gravidarum*, *posthemiplegic chorea*, *choreic insanity*, and *electric chorea* or *Dubini's disease* (which is marked by the sudden character of the spasms).

Inco-ordination characterizes chorea in children. The child's control over the muscle movement is partially or entirely lost. In addition, there are involuntary muscle movements and twitchings, and there is loss of muscle power.

**Etiology.**—The disease occurs more frequently in girls than in boys. The proportion in a group of our own cases has been two to one.

The susceptible age is from the sixth to the tenth year, the range in our cases having been from four to sixteen years. These observations are in accord with those of other writers.

Fright as a factor in causing chorea has been greatly overestimated. In a susceptible child the occurrence of stress of any nature may induce an attack. Regardless of the nervous shock, there is no chorea without the underlying constitutional cause. Overwork at school is to

<sup>1</sup> New York State Med. Jour., October, 1916.

be looked upon as a predisposing cause, as also is anemia or any influence affecting the well-being of the child. But such factors are operative only in favorable subjects.

Basing our judgment on a large number of cases both in private and hospital work, we agree with the accepted opinion of most writers that rheumatism takes a first place in the etiology. Strümpell several years ago wrote that the association of chorea and rheumatism is so close that it is impossible to separate them. Hirt, in discussing nervous diseases, expressed the view that there is a common toxic etiologic factor which, affecting the cortex, produces chorea, but affecting the joints gives rise to acute articular rheumatism. The association of rheumatism and chorea is certainly most intimate. At least 50 per cent. of our cases either have given a history of rheumatic manifestations, or shown evidence of rheumatism when first seen, or developed the signs later. If to the above are added the cases of chorea in which there is a family history of some form of rheumatism, the percentage is increased to over 80 per cent. The association so generally observed clinically is further demonstrated by the results of treatment.

In the etiology of chorea as well as rheumatism the influence of diseased teeth and tonsils is unquestionable.

Exceptionally eye strain appears to be an important contributing factor.

Lyttle and Sutton<sup>1</sup> have demonstrated an accelerated Kottman reaction indicating defective thyroid activity in a small group of chorea cases and have employed thyroxin as of possible aid in such cases.

**Pathology.**—Much has been written concerning the pathology of chorea and widely diverse opinions are held. The fact that the child makes a complete recovery in a few weeks, and that no permanent lesion is demonstrable after several acute attacks, proves that there is no grave lesion.

Poynton and Paine claimed to have found the "diplococcus of rheumatism" in films made from the pia mater in a fatal case of chorea. The cocci were seen in the vicinity of a blood-vessel. Poynton<sup>2</sup> gave a cut showing this condition. Morse and Floyd found cocci in the blood in 4 out of 31 chorea cases studied, but their work proved nothing definite. Richards<sup>3</sup> reported 2 cases in which *Streptococcus viridans* culturally identical with the streptococcus of Shottmueller and that of Poynton and Paine was found in the blood. Notwithstanding these suggestive findings, however, the specific etiology and pathology of chorea is still by no means conclusively established.

The spinal fluid is clear. In about 30 per cent. of cases Morse and Floyd found a very slight increase in the number of cells, all of which were mononuclear in type. No micro-organisms are present.

**Symptoms.**—The onset of symptoms is most variable. Usually the child will show apparent awkwardness in using one of the hands, or will stumble in walking, or will exhibit a hesitancy in speech which is unusual. Such symptoms will be present for a week or more and the child

<sup>1</sup> Amer. Jour. Dis. Child., August, 1923, pp. 179-185.

<sup>2</sup> The British Journal of Children's Diseases, 1912, vol. ix, p. 49.

<sup>3</sup> Jour. Amer. Med. Assoc., lxii, 1914, pp. 110, 111.

will usually be reproved for his awkwardness in handling his drinking glass, knife, or fork. The condition may go no further than this, or, as is usually the case, the nervous manifestations continue. The arms, hands, and fingers may twitch and show short clonic contractions of certain muscles. At the commencement one arm is usually involved more than the other. This tendency to unilateral involvement may continue through the attack. The order of involvement is usually the right arm, left arm, right leg, and left leg. The limb involved is much weaker than its fellow. This, in the examinations of the upper extremities, may be readily appreciated by asking the patient to squeeze the examiner's hand, the patient using first one hand and then the other.

The muscles of the face or of the shoulders may be prominently involved, but this is unusual.

In association with the involuntary muscular contractions there is lack of co-ordination, a further development of the awkwardness seen early in the attack. The movement of the hand, for example, is slow or absolutely refuses to obey the will, and is only accomplished after pronounced effort or not at all. Thus when a choreic patient is told to place the tip of one index-finger on the tip of the nose or the tip of each index-finger alternately on the tip of the nose in rapid succession, returning the arms in an extended position to his sides, the child experiences much confusion, and the fingers rarely reach the tip of the nose. Another test is to extend the arms in an outward direction and then bring the tips of the index-fingers together quickly. The choreic patient will experience much difficulty in its accomplishment. We have had a number of patients under ten years of age who were confined to their beds and who could perform no voluntary act of such complex nature as self-feeding and walking.

Muscle instability may be further demonstrated by the inability of the patient to maintain muscle tension. Thus, wrinkling the brows or holding the eyes tightly shut can be continued but a few seconds. When the child is asked to protrude the tongue and keep it protruded, the organ may undergo various contractions until it is under control, and even when at rest will show fine fibrillary twitchings. The facial muscles offer a large field for muscle gymnastics with grotesque effects. All or any of the voluntary muscles may be involved. There is generalized inco-ordination, and lack of power and muscle control.

**Diagnosis.**—The diagnosis is made on the presence of muscle contractions beyond the control of the will, resulting in awkwardness, grimaces, and inability to effect voluntary effort. Chorea is to be differentiated from habit spasm—so-called “habit chorea”—by the fact that, in the latter, while there are contractions of various sets of muscles in the body, such contractions may be controlled by mental concentration, whereas in true chorea the attempt at control exaggerates the inco-ordination. Chorea, furthermore, is a form of inco-ordination of the so-called cerebellar type, and, like alcoholic intoxication, does not lend itself to voluntary mimicry by one unaffected.

The choreiform type of encephalitis may be distinguished by the history of the case, by associated manifestations such as ocular paralysis, and, if the case be early, by the spinal fluid findings. (See p. 623.)

**Prognosis.**—The prognosis is good. Of a large number of cases we have never known one that did not undergo recovery if the patient was free from cardiac involvement. We have seen fatal cases of pancarditis (endocarditis, myocarditis, and pericarditis) in which chorea was one of the symptoms of the rheumatic infection, but in every case it was the heart involvement that killed the patient. Among 250 cases of chorea Still noted the presence of cardiac bruits in 155.

**Recurrence.**—As with other rheumatic manifestations in children, there is with chorea a marked tendency toward a recurrence. In its causation there is, moreover, a seasonal element. The majority of the cases occur in the spring months. It has not been our observation that the fall of the year is a predisposing factor. Repeatedly in out-patient work where continuous supervision is impossible one may see these choreic children return year after year for treatment.

**Duration.**—The duration of these cases depends upon the nervous organization of the child, the severity of the attack, and the co-operation to be gained from the patient's family. Fairly severe cases have terminated in recovery in six weeks, and others have required six months of treatment.

**Treatment.**—*Rest Treatment.*—The management of chorea depends entirely upon the severity of the attack. It may be necessary in extreme cases to keep the child in bed from three to four weeks. In other cases, in which the attack is milder in character, the enforced rest may do harm. When the involuntary movements are so marked as to interfere with locomotion and prevent the child's feeding himself, rest in bed for a week or two is strongly advised. In our opinion it is mental repose that the patients particularly require, and if this can best be obtained in bed, then the bed is the best place for the patient. If an absence of mental excitement and stimulation can be secured with a reasonable amount of outdoor life and exercise, so much the better. An important fact to be remembered in the management of choreic children is that they must not be allowed to become fatigued either physically or mentally.

For the patient who has been confined to bed for several days or weeks a gradual return to the usual habits is best. The child should be taken up for one-half hour the first day, increasing the time out of bed one-half hour daily, until he returns to his usual habits of life.

*School and Entertainments.*—Specific instructions as to the amount of physical and mental rest required cannot be given so as to apply generally in the management of chorea. School and entertainments for the choreic patient are, however, out of the question, no matter how mild the case. In the great majority of cases play with other children must be prohibited. Books and play of an exciting nature are to be avoided and there must be no mental stimulation whatever, and no bodily fatigue. How best to bring this about depends upon the child and his environment.

*Illustrative Cases*—In two instances it was found necessary to remove the patient from his home to a place with outside relatives, as the influence of the mother in each instance was such as hopelessly to prevent the child's recovery.

In a severe case of a boy of twelve years, a college student was selected to turn the patient's attention to boyish things, games, target practice, horseback riding, etc.

The boy was kept in bed until 9 A. M., rested two hours after the midday meal, and retired at 7 P. M. He was practically well in four weeks.

*Antirheumatic Treatment.*—By treating every case of chorea as though the disease were rheumatism, results are strikingly good. The tonsils should receive careful attention, and in the event of repeated attacks enucleation should be practised.

*Drugs.*—The salicylate of soda may be given in smaller doses than are used in acute articular rheumatism—about 10 grains three times daily, with double the amount of bicarbonate of soda, being suitable for a child from six to ten years of age. The soda should be given between meals. To children of this age the salicylate may be given either in capsule or in solution. To young children drugs in solution are more easily administered. In using salicylate of soda for a considerable time it is well to remember that it may interfere with the appetite and digestion, no matter how great the care exercised in its use. For this reason it is well to give it intermittently—five days of medication being followed by five days without medicine.

In spite of the value of the antirheumatic treatment, this alone will not always answer. The administration of arsenic and the salicylate and the dietetic régime may best be begun at the same time. The salicylate of soda should be given at once at the commencement of the treatment in as full doses as we expect to give. Arsenic should be commenced in a small dose, which is to be gradually increased in order to establish a tolerance of the drug. Fowler's solution of arsenic is usually employed. In order that no error be made in its administration, a table similar to the following is given to the mother or attendant. To a child six years of age on the first day 2 drops should be given after each meal, as indicated below. Thereafter the dosage should be increased by 1 drop every twenty-four hours, according to the following schedule:

DOSEAGE OF FOWLER'S SOLUTION FOR A CHILD SIX YEARS OLD

1st day:	Morning,	2 drops.	Noon,	2 drops.	Night,	2 drops.
2d	"	" 2 "	"	" 2 "	"	" 3 "
3d	"	" 2 "	"	" 3 "	"	" 3 "
4th	"	" 3 "	"	" 3 "	"	" 3 "

This rate of daily increase may be continued up to the third week, after which time the dosage should range from 5 to 10 drops three times a day. For a child of eight to ten years of age the amount may be increased to 12 or 15 drops three times a day. By putting the patient on the antirheumatic treatment it has seemed that much less arsenic is required, and that the patient usually makes an earlier recovery. We have never been obliged to resort to the large dosage of 25 to 30 drops of Fowler's solution three times a day as suggested by Seguin. It is exceedingly rare that more than 10 drops three times daily will be required in order to procure satisfactory results. We have never found it necessary to give more than 12-drop doses to girls of thirteen to sixteen years old.

*Illustrative Case.*—A very aggravated case in a girl fifteen years of age terminated in complete recovery in three weeks under the antirheumatic diet, the use of aspirin, 10 grains three times daily after meals, and Fowler's solution up to 12 drops after each meal.

Children vary greatly as to their tolerance of arsenic.

A boy seven years old could not take more than 4 drops of Fowler's solution three times a day.

In giving arsenic mothers should therefore be advised that in the event of abdominal pain, diarrhea, coated tongue, foul breath, vomiting, or puffiness under the eyes the drug is to be discontinued for at least two days. The minimum dose may then be resumed with the same gradual increase.

With the improvement of the case the diet should be continued. The medication may gradually be reduced after all the symptoms have disappeared. It should be continued, however, in from one-third to one-half the quantity for three weeks after the disappearance of all nervous symptoms.

*Supplementary Treatment.*—It should be remembered that children who have once had chorea are very susceptible to recurrent attacks just as are children who have had rheumatism. After one attack of chorea the danger of a recurrence should be explained to the mother, who should be asked to bring the child for examination at the first suggestion of involuntary muscular twitching. In addition to this, children who have had chorea, as well as those who have had only rheumatism, should be allowed meat in small portions only, and in no case should an excessive use of sugar be permitted. Candy is usually to be forbidden. Because of the frequent coexistence of rheumatism when the attack is over the writer has ordered that the child shall receive 10 grains of bicarbonate of soda three times daily for five days out of every fifteen. In this way, under a reasonably quiet home life, with no school contests for prizes, a recurrence will almost invariably be prevented.

Goodman reported good results from autoserum therapy consisting of injections into the spinal canal of blood-serum taken from the patient. This practice, however, has received little support. A trial of the method carefully conducted by the Children's Medical Division at Bellevue Hospital yielded no favorable results.

### HABIT SPASM (TIC)

By habit spasm is understood a semi-inco-ordinate movement of some portion of the body. The term "semi-inco-ordinate" is used advisedly, because the spasm may be controlled when the child's attention is directed to it, this being one of the distinguishing features which differentiates it from chorea, in which efforts at control make the spasm worse. The muscles involved in the spasm are usually those of the head, face, or arm. The nose may be drawn up, the chin down, or the head to either side. The muscular spasm is worse when the patient is tired, and occurs more frequently under excitement. While children thus affected cannot be said to have chorea, there is nevertheless a close association between habit spasm and true chorea.

Several of our patients developed habit spasm from association with children who had some special grimace or habit of muscle contraction of their own.

The cases are readily curable when taken early. In a neglected child the spasm may become fixed and continue during the life of the individual. Instances of this sort are often seen in adults. Bad subjects will transfer the spasm from one set of muscles to another.

*Illustrative Case.*—A boy, twelve years old, came for assistance because of a peculiar explosive sound similar to that made by eructations of gas. The sound was produced through some process of laryngeal gymnastics and was almost continuous when awake.

**Treatment.**—The management is dietetic, hygienic, and medicinal.

*Diet.*—A small portion of red meat may be allowed once a day. Sugar may be given in sufficient amount to make the food palatable. The vegetable and legume constituents in the diet are to be made prominent. The patient will usually be found to be poorly nourished and often suffering from a secondary anemia, so that a diet best calculated to improve his general condition should be insisted upon. This should contain milk, eggs, poultry, fish, red meat in small portion, high-protein cereals, and the legumes.

*Bath.*—A salt bath should be given at bedtime, and immediately after the bath goose oil, unsalted lard, or olive oil should be rubbed into the skin.

*School Duties.*—Temporary absence from school, or a lightening of school duties, and an outdoor life are essential in the successful management of a case. The child should not be allowed to do anything of a strenuous nature. Hard play and any amusement of an exciting character should be forbidden. Fatigue must be avoided. Rest after the noon-day meal for an hour or two is strongly recommended.

*Medication.*—The medicinal treatment suggested for chorea is also applicable here. If there is anemia, iron may be given, conveniently in the form of extractum ferri pomatum,  $\frac{1}{3}$  grain three times a day. For those children who cannot take cream or butter, cod-liver oil in teaspoonful doses is a valuable addition to the treatment. The iron may be alternated with the cod-liver oil, each being given for five days. If there is a rheumatic history or inheritance, salicylate of soda is to be given in capsule with the iron. The following is useful for a child five years of age:

R.	Liquoris potassii arsenitis.....	gtt. iij
	Ext. ferri pomati.....	gr. ss
	Sodii salicylatis.....	gr. v
M.	Sig.—One dose; to be given in capsule after each meal.	

The use of arsenic, while of advantage, does not appear to be as valuable as in the treatment of chorea.

*Moral Treatment.*—Habit spasm, for the reason that it is practically under the control of the will, should be discouraged, rewards being given and punishments imposed, as seem to answer best.

## STAMMERING

Stammering is an affection for the most part limited to self-conscious and precocious children with indifferent nervous control. The defect is seldom of importance before the fifth year, and then usually may be found to be due to imitation of other stammerers. About 35 per cent. of the patients are said to have relatives similarly affected.

Boys are more frequent victims than girls. Fright gives rise to the condition in many instances, and in many the history will show that the child has been subjected at an early age to repression and nagging conducive to psychic instability. Of the concrete causes the most important are adenoid and tonsillar hypertrophy, high palatal arch, imperfect epiglottis, and short frenum linguæ. The respiratory muscles commonly do not co-ordinate properly with the speech muscles and thus the subject even when in the act of articulating may lack the necessary voice. In the most pronounced cases not only the lips and tongue but also the face and limbs participate in the loss of control, so that the child's self-reliance becomes greatly weakened.

**Treatment.**—All measures that conduce to stability of the nervous system are of value in the cure of stammering. According to Hollander, the best results are gained from suggestion treatment intended to increase the patient's self-confidence and emphasize the importance of his ideas, rather than his manner of utterance. In dealing with older children psychotherapy directed to the eradication of the complex of which the stammering is perhaps only a phase may be of greatest value. Anatomical abnormalities should be corrected and breathing exercises should be instituted to encourage better poise and co-ordination. Syllabication is a practice of special value.

In the large centers there are clinics for the treatment of speech defects, and the results gained by specialists in this department amply justify the formation of more such classes under trained supervision.

## THE PROGRESSIVE MUSCULAR ATROPHIES

The progressive muscular atrophies fall easily into two main groups, called the *amyotrophies* and the *myopathies*. In cases of the first class there are lesions in the spinal cord. In cases of the second group such changes are not found.

### PROGRESSIVE SPINAL MUSCULAR ATROPHY OR PROGRESSIVE AMYOTROPHY

This disease has received many designations, including the following: *Chronic anterior poliomyelitis*, *wasting palsy*, *Charcot's disease*, *Duchenne-Aran's disease*, and *amyotrophic lateral sclerosis*.

Some justification for the existence of so many terms is found both in the variable pathologic conditions and also in the length of the period of painstaking research which has made possible our present knowledge of the disease. The conditions observed are, however, fundamentally similar and admit of a common classification.

**Etiology.**—Progressive amyotrophy is uncommon in early childhood, although Werdnig and Hoffmann have recognized a hereditary form occurring in the very young. Older children and young adults are more frequently affected, and in such instances there is usually no family history of this paralysis, and the disease can be ascribed only to such uncertain causes as exposure, overwork, injury, or previous infectious fevers, including poliomyelitis of the acute type. An exception to this rule occurs in the case of progressive muscular atrophy of the Charcot-Marie or leg type. This form is quite definitely a family disease.

**Pathology.**—The essential change common to all types is atrophy

and degeneration of the anterior cornua of the spinal cord. This process involves the cord vertically and is followed by degeneration of the peripheral nerves and the muscles which these nerves supply. Secondary changes in the cord substance consist chiefly of sclerosis and pigmentation which invade the pyramidal tracts and also, in most cases, the anterolateral ground bundles. Although the cervical and upper dorsal regions are principally affected, the disease may also attack the lumbar region or the motor nerve-cells of the medulla, which supply fibers to the lips, tongue, pharynx, and larynx. Muscular atrophy of the leg type has been regarded as a disease of neural rather than of spinal origin. This form, however, cannot be classed with the myopathies, and quite probably develops from primary degeneration in the anterior cornua.

In a certain proportion of spinal muscular atrophies a marked sclerosis of the lateral columns supplements the usual changes secondary to atrophy of the cells in the anterior horns. "The degenerative process attacks first the terminal fibers and collaterals of the cortical motor neurons. It seems to destroy the tips of the nerve processes, so to speak, without involving the nerve-cell body itself. The next part attacked is the anterior cornual cell" (Dana). Under these conditions the progressive amyotrophy assumes a spastic form and is called *amyotrophic lateral sclerosis*.

Until the complex pathology which has just been briefly traced is further elucidated, the following neurologic conditions may be classified under the general heading "progressive spinal muscular atrophy":

1. *Progressive amyotrophy of the hand type (or Duchenne-Aran type).*
2. *Progressive bulbar paralysis.*
3. *Progressive muscular atrophy of the leg type (peroneal type or Charcot-Marie-Tooth type).*
4. *Progressive spinal muscular atrophy of the spastic type (or amyotrophic lateral sclerosis).*

**Symptomatology.**—1. *Progressive amyotrophy of the hand type* typically begins as a wasting of the muscles of one thumb. The adductor pollicis, deep thenar, hypothenar, and the interossei muscles are progressively involved; and as the paralysis extends, it may affect the flexors and extensors of the forearm, and eventually the triceps and deltoid and other shoulder muscles. The "claw-hand" deformity is common. After several months the paralysis may become bilateral, involving the trunk and rarely the leg muscles, or it may even develop into a bulbar palsy. The paralysis in the hand type of atrophy is usually atonic and flaccid, but may assume a spastic character, with exaggerated reflexes, thus simulating amyotrophic lateral sclerosis. The varying degrees of atony and spasticity are many. In most cases fibrillary contractions occur. Electric responses are diminished and partial or complete reactions of degeneration may be elicited. Complete reactions of degeneration belong, as a rule, to cases of rapid course. Occasionally rheumatoid pains and local paresthesias occur, but sensory disturbances are for the most part lacking.

2. *Progressive bulbar paralysis* is unusual in children. Occasionally it marks the termination of an advancing amyotrophic lateral sclerosis or ophthalmoplegia. Dysphonia and dysphagia are the cardinal symp-

toms. Localized fibrillary twitchings may occur. Electric irritability is gradually diminished.

3. *Progressive muscular atrophy of the leg type* attacks first the peronei, then the anterior tibial muscles and the calf muscles, and, at a late stage, the adductors of the thigh and gluteal muscles.

In cases of the so-called ascending type the arms and trunk may become affected. At the outset the paralysis and atrophy are unilateral. Fibrillary twitchings and diminished electric responses are observed, but there are no significant sensory symptoms.

4. *Progressive spinal muscular atrophy of the spastic type* combines the symptoms of tonic paralysis with those of progressive wasting. The affected extremities are stiff and weak, reflexes are exaggerated, and in certain instances the lips, tongue, and larynx may be involved.

**Course and Prognosis.**—In all these conditions the course of the disease is very chronic and extends over a period of years. The progressive amyotrophies are apparently incurable, though remissions in the symptoms are frequent. Atrophy of the leg type is said to offer the best prognosis.

**Diagnosis.**—Cases of progressive muscular atrophy in children are to be distinguished from those of primary myopathy, peripheral neuritis, acute poliomyelitis, and hereditary ataxia. The individual forms of amyotrophy should also be distinguished. Without attempting to enumerate all the factors valuable in these differentiations we may group together the following points:

In the *amyopathies*: Family history and absence of fibrillary tremor and reaction of degeneration.

In *neuritis*: Symmetric distribution of paralysis, possible toxic origin, frequent existence of sensory symptoms, and absence of family history.

In *epidemic poliomyelitis*: History of acute onset and rapid course.

In *hereditary ataxia*: Characteristic tottering gait, normal electric reactions, and hereditary influence.

**Treatment.**—This is only symptomatic and palliative. Electricity may be applied to the wasted muscles and to the spine. The drugs used are calculated to exert a tonic action on the nervous system, and include iron, arsenic, quinin, and strychnin. Mercury and potassium iodid may be tried in cases of possible syphilitic origin.

#### THE PROGRESSIVE MYOPATHIES (PRIMARY MUSCULAR DYSTROPHIES)

These include three types:

1. *Pseudomuscular hypertrophy* (Figs. 108–110).

2. *Progressive muscular atrophy of Erb's juvenile type, or the scapulo-humeral type.*

3. *Infantile myopathy of the facioscapulohumeral type, or Landouzy-Déjérine type.*

**Etiology.**—In these cases there is very frequently definite evidence of heredity. With the exception of the juvenile dystrophy of Erb, which occurs most frequently in early youth, these conditions begin to develop before puberty, usually between the third and tenth years. Pseudomuscular hypertrophy is more common in boys than in girls, yet is apparently transmitted through the maternal parent. While in many

instances the first symptoms of weakness follow an acute illness, it is doubtful whether trauma and acute diseases are truly causative factors.



Fig. 108.—Pseudomuscular hypertrophy. (Early case.)

**Pathology.**—According to Erb, the muscular changes are essentially due to trophic disturbances. In spite of this there are no demonstrable primary lesions in the nerves or spinal cord. In the muscles themselves



Fig. 109.—Patient shown in Fig. 108, continuing the attempt to rise.

there is a complex degenerative atrophy which is characterized by a preliminary increase in the size of the muscle-fibers and the number of nuclei, followed by disintegration of these fibers, increase of connective

tissue, and lipomatosis. Although the degeneration is attended by hypertrophy, the end-result is, therefore, atrophy.



Fig. 110.—Characteristic completion of the act begun as shown in Fig. 108.

**Symptoms.**—These have been conveniently outlined by Sachs<sup>1</sup> as follows:

#### TYPES OF PRIMARY DYSTROPHIES

	Muscular pseudohypertrophy.	Juvenile form of progressive muscular atrophy (Erb's type).	Landouzy-Déjérine type.
Part first affected:	Legs (calves).	Shoulder-girdle.	Face and shoulder-girdle.
Distribution of hypertrophy:	Calves, rarely thighs.	Muscles around shoulder-girdle and pelvic girdle.	None.
Distribution of atrophy:	Thighs, deep muscles of back, shoulder and scapular muscles. Calves during later period; at that time also general atrophy.	Thighs, deep muscles of back, upper arm. Hypertrophied parts may become atrophic in later stage.	Face muscles, including lips and orbicularis palpebrarum; shoulder and scapular muscles.
Parts remaining normal:	Face, forearm, and hand, except in last stages.	Face, forearm, hand and leg muscles, except in last stages.	Forearm, hand, and legs, and deep muscles of back.

<sup>1</sup> Nervous Diseases of Children.

The "waddling gait," difficulty in rising from the floor (Fig. 108), and large, hard calf muscles constitute the most prominent features of the pseudohypertrophic form. The "myopathic face" distinguishes the Landouzy-Déjérine type.

In all the forms there are no fibrillary twitchings and no complete reactions of degeneration. The reflexes may be normal. As the paralysis progresses they are diminished.

**Diagnosis.**—The primary muscular dystrophies are not often confounded with other diseases. A consideration of the history, together with a study of the electric and mechanical behavior of the affected muscles, will usually render easy the distinction between a case of myopathy and one of amyotrophy.

**Course and Prognosis.**—These cases extend over a period of many years, usually terminating in death from some secondary disease.

**Treatment.**—Orthopedic measures designed to correct existing deformities and complement the action of partially degenerated muscles afford the best results. Moderate massage and judicious use of electricity and exercise are of value. Further treatment consists only in the maintenance of nutrition and the administration of drugs to relieve temporary symptoms as these may arise.

#### AMYOTONIA CONGENITA (OPPENHEIM'S DISEASE)

Amyotonia congenita was described by Oppenheim<sup>1</sup> in 1900 as "a condition of extreme flaccidity of the muscles, associated with an entire loss of deep reflexes, most marked at the time of birth, and always showing a tendency to slow and progressing amelioration. There is great weakness, but no absolute paralysis of any muscle. The limbs are most affected, the face is almost always exempt. The muscles are small and soft, but there is no local muscular wasting. Contractures are prone to occur in the course of time. The faradic excitability in the muscles is lowered, and strong faradic stimuli are borne without complaint. No other symptoms indicative of lesions of the nervous system occur."

By many authorities amyotonia congenita is grouped with the pseudo-muscular dystrophies with which it has points in common.

**Etiology.**—The cause is not known.

**Pathology.**—In some cases there is degeneration in the anterior horns of the spinal cord, but this is not constant. The chief lesions are in the muscles which show atrophy and degeneration.

**Symptoms.**—The cases show all degrees of severity, from a slight weakness which passes entirely unnoticed to a well-marked disability which represents a flaccid paralysis, in which the child is perfectly helpless. In the latter cases the knee-jerks are absent and the electrical reactions are very weak.

The change in an electrical response is quantitative only and without reaction of degeneration. There is no obvious atrophy of tissues and the child may be well nourished. Paralysis of the lower extremities is often nearly complete, but in the upper some movement can, as a rule, be obtained. The diaphragm and facial muscles, as a rule, escape, although the face may be slightly involved. The intercostal and neck muscles are

<sup>1</sup> Monatschr. f. Psychiat. u. Neurol., 1900, viii, 232.

often affected. The feet characteristically show pad-like development. Contractures may develop later in the disease. If the intercostals are involved the respirations may be labored and diaphragmatic in character. Choking attacks occur from accumulation of secretion in the pharynx. There is no sensory involvement or sphincter disturbance. Mentality is normal.

**Diagnosis.**—Amyotonia congenita may be confused with exceptional types of poliomyelitis of long duration. The history, distribution of the flaccidity, and the electric reactions are of importance in making the differentiation. The negative family history and the muscular weakness without the atrophy which one would ordinarily look for are typical of amyotonia congenita in distinction from muscular atrophy.

**Prognosis.**—The severe forms often end in death from some intercurrent infection, such as broncho-pneumonia. The mild forms may continue for years and even show some improvement.

**Treatment.**—Massage and electric treatment may be given, but they do not offer much hope.

## EPILEPSY

"Epilepsy," according to Spratling, "is the strangest disease in human history. It respects no race, no class, no age, no occupation. It may be in the infant at birth or delayed till extreme old age, even ninety years or more." Some of the most notable characters in history, including Cæsar and Napoleon, are reported to have been its victims, and the existence of the affection in very remote times is proved by the ancient descriptions of *morbus sacer* and *morbus comitialis*. The term "*falling sickness*" best corresponds to Lucretius' portrayal of how the patient, "struck as with lightning," drops; while *morbus Herculeus* might well characterize the second stage of a severe seizure.

Today, in spite of a growing knowledge of contributory causes, most potent of which is heredity, we are still ignorant of the essential nature of the disease.

Statistics serve to show that alcoholism in the parents is an underlying factor in many cases of epilepsy. Woods has reported 7 cases of epilepsy in children which he traced to single alcoholic intoxication on the part of one or both parents, otherwise teetotalers. He quoted Déjérine, who stated that 51.5 per cent. of all cases in children are due to parental alcoholism and but 21 per cent. to parental epilepsy; also Binswanger of Germany, who declared of epileptics "made in Germany" 22 per cent. had their origin in chronic parental inebriations while but 11 per cent. were due to parental epilepsy. Woods advanced the belief that it is not so much chronic drunkenness as drunkenness at the time of conception that causes the transmittal of an often overwhelming neurosis to offspring.

Statistics further show that from one to three persons in every thousand throughout Europe and America are epileptics, the proportion of males being slightly in excess.

Lengthy discussions will be found in works on neurology relating to various features of the disease. To these works the reader is referred, although in them he will find but little that is conclusive.

Epilepsy is not a disease of infancy, and while cases occur in children under one year of age, such occurrences are relatively rare. We have treated a large number of children who have had infantile convulsions and who never developed epilepsy. Neurologists are inclined to attribute a varying percentage of the cases of epilepsy to infantile convulsions, dentition convulsions, etc. The neurologist does not always comprehend the hundreds of such cases seen by pediatricists and practitioners in which there is never further trouble. While a certain percentage of epileptics may have had convulsions in infancy, a much larger percentage of infants have convulsions without subsequent epilepsy. The *petit mal* type has appeared to be the more characteristic infantile form.

Koplik states, "Epilepsy bears no demonstrable relation to infantile convulsions. The fact that the patients developed the disease at an early age helps in no way to explain the condition, and the underlying factors in epilepsy are the same regardless of the age of the patient. Thus what constitutes epilepsy is yet to be determined. Various brain lesions have been found in association with epilepsy, and to them the seizures have been attributed, and yet these lesions and more pronounced involved areas are found at postmortem without the occurrence of epilepsy."

**Types.**—Clinically, epilepsy may be divided roughly into two types, *petit mal* and *grand mal*.

*Petit Mal.*—This form may occur independently, or in association with *grand mal*. One person may be subject to both kinds of attacks. In *petit mal* there is a temporary or partial loss of consciousness without convulsion. The child may simply hesitate in his play and grow pale. There is a dull look in the eyes, then the attack is over, and the play is resumed. The attack may manifest itself in what corresponds to a fainting attack, in which the child loses color and sinks to the floor, but is normal in a few moments.

*Illustrative Cases.*—A girl two years old with a good family history had two "fainting attacks" on two successive days. The attacks apparently consisted of a temporary clouding of the mentality, with a tendency to fall. During the next two years the child had six of these attacks.

In another child the only signs of the disease were manifested by a sudden cessation of play, when the patient would gaze into space for a few seconds only, with dilated, fixed pupils and a vacant stare.

*Grand Mal.*—The epileptic attack is in most cases preceded by prodromal symptoms, known as "*the aura*," which consists of a warning by which the patient knows the attack is coming on. The aura is described as a peculiar sensation felt in some portion of the body before the attack and at no other time.

*Illustrative Cases.*—A boy patient had what he described as a pain in the side. It was always in the same side and the area of the pain was not larger than a silver dollar.

Another boy patient of eight years could always anticipate an attack through a feeling which he could not describe in the right leg, and which traveled up to the abdomen.

Numbness, tingling, and a feeling of soreness in the stomach have all been described as constituting the aura.

In *grand mal* there are loss of consciousness, dilatation of the pupils,

foaming at the mouth; stertorous breathing, and biting of the tongue due to spasm of the jaw muscles. The muscle spasm gradually lessens, consciousness slowly returns, and the patient passes into a deep sleep. Every variation of the above symptoms may be encountered.

The character of the convulsive movement may help to determine the nature of the disease. Localization of spasm in one portion of the body or one set of muscles indicates some distinct focal lesion in the brain.

**Diagnosis.**—The diagnosis of epilepsy is not difficult. Repeated convulsions after the age of infancy are always epileptic. An infant may have repeated convulsions and yet not have epilepsy. We have seen this time and again. However, if a child two or more years of age has repeated convulsions, even at intervals of several months, the condition must be looked upon as epilepsy, because children do not have repeated innocent fainting spells. Neither are hysteric seizures at all common, and when they do occur they simulate epilepsy to such a slight degree that a differentiation is superfluous.

*Illustrative Case.*—A girl of fifteen had a nocturnal attack. During the ensuing twelve years up to the age of twenty-seven there were but five seizures, all at night.

Cases of this nature constitute epilepsy just as truly as though the attacks had occurred in as many months.

**Prognosis.**—The prognosis of epilepsy as to a cure is bad. The outlook for many patients is hopeless; nevertheless, under a régime involving right living, proper diet, and avoidance of excitement, many epileptics undergo but little inconvenience.

There are plenty of examples in history of men who were epileptics and yet gained marked distinction.

**Treatment.**—In the management of epilepsy practically all we can hope to do is to diminish the frequency of the attacks which characterize the disease, whether the case be one of grand mal or petit mal. Proper nutrition, rational habits of living, and pleasant outdoor occupations are of inestimable service in the management of the epileptic. The management which has proved best has been directed, first, along general and hygienic lines; second, it has involved the use of drugs. Our aim should be to make the patient physically as normal, as vigorous, and as resistant to attacks as lies in our power.

*General Considerations.*—Visual defects, enlarged tonsils, adenoids, phimosis, and irritant skin lesions must all be corrected before beneficial results are to be expected from any line of treatment. The patient should then be placed under the best environment permitted by his station in life. Outdoor life, sports, and games are to be encouraged, always within the bounds of moderation. The child should sleep in a cool room with the freest possible ventilation at all seasons of the year. If he is a school child, he should, if possible, be instructed at home and given short sessions with easy studies. In work or play he should never be allowed to reach the point of mental or physical fatigue. This is most important. Emotional plays at the theater and exciting amusements elsewhere should be forbidden.

*Diet and Bowel Function.*—The diet is to be adjusted to the child's digestive capacity. A diet suitable for the age is to be given, just as for

the normal child (p. 135), meat being allowed only once a day. As intestinal indigestion and toxemia from intestinal sources are unquestionably important etiologic factors in causing a recurrence of the seizures, careful attention to the bowel function and diet are most important features of the treatment. The epileptic patient should never be allowed to pass over twenty-four hours without an evacuation of the bowels, and if, in the opinion of those in charge, the evacuation is not as copious as usual, an enema should be given. If there is a suggestion of constipation, the treatment with the oil enemata, or other means as recommended for chronic constipation (p. 267), is to be instituted. In cases in which heredity and toxic influences prevail, the importance of attention to the diet and habits of life cannot be overestimated. When there is a focal lesion, attention to the details of living will have less influence, but always, surely, *some* influence, in diminishing the frequency and severity of the seizures by establishing a more vigorous physical resistance.

*Colony Management.*—During the past half-century the colony treatment, which began in Germany with a successful private attempt to house 4 patients separately, has become wide-spread, and at present this method promises the most practical and far-reaching results. When parents are unable to give the patient suitable attention at home, he should be placed in one of the excellent institutions devoted to the care of epileptics, where the whole manner of life is adjusted and regulated with one object in view.

*Drugs.*—There are few drugs in the pharmacopeia, particularly those of a sedative nature, that have not been used at one time or another in the treatment of epilepsy. The bromids unquestionably have long served our purpose in controlling the seizures better than has any other form of medication. The size of the dose is variable. Because of their peculiarly depressing effects upon the child's mental condition the bromids should be given in as small quantities as are compatible with the beneficial result desired—a diminution in the number of the convulsions. To a child ten years old, 10 grains of sodium bromid ordinarily may be given, well diluted, in  $\frac{1}{2}$  glass of water after meals. The amount may be increased or diminished as the progress of the case indicates. If the convulsions are nocturnal, in a child of ten years, large doses—from 20 to 30 grains—should be given at bedtime. In the event of the discontinuance of the drug to the point where it is given but once a day, the time selected should be bedtime. If there is continued improvement under the bromid, it may be given on alternate nights, and finally every fourth night.

Luminal in dosage of from 1 to 2 grains daily is a remedy of considerable value in cases in which the bromids are not suitable.

As ocular defects may be important factors in causing epilepsy, every child with epilepsy should have the eyes examined by a competent oculist.

*Illustrative Case.*—In a young woman already referred to (p. 585) the first convulsion occurred at the fifteenth year as a typical nocturnal seizure. Fifteen grains of bromid with 5 drops of the tincture of belladonna were given three times daily for three months, then the bromid was reduced to 30 grains daily. This was continued for one month, when a death occurred in the family which doubtless helped to incite a second attack. At this time, as the patellar reflex was scarcely perceptible and the bromid rash was

considerable, the drug was discontinued. At the end of two months the daily dosage was placed at 20 grains, with 10 drops of tincture of belladonna. This was continued for four weeks, when there was a third attack, without any apparent cause of an exciting nature beyond the fact that the patient had allowed herself to become obstinately constipated. This was her last attack.

### ACUTE POLIOMYELITIS (INFANTILE PARALYSIS)

Anterior poliomyelitis is an infectious and widely transmissible disease affecting most intensively the anterior cornua of the spinal cord.

**Etiology.**—From the brain and spinal cord of human cases of poliomyelitis, as well as from experimental cases of the disease in monkeys, Flexner and Noguchi<sup>1</sup> cultivated, by anaërobic methods, a globular or globoid body smaller than any known coccus, 0.15 to 0.3 $\mu$  in size, and staining pale reddish violet by Giemsa's solution. Noguchi also demonstrated identical bodies in films prepared directly from the nervous tissues. The organism belongs to the filtrable viruses.

These cultures, when inoculated into monkeys, have caused typical experimental poliomyelitis.

**Seasonal Influences.**—While the disease may appear at any season of the year, a vast majority of the cases develop between July and October.

**Age Incidence.**—Although poliomyelitis is a disease of childhood, cases occurring in adults are not at all uncommon. In some recent epidemics adults have numbered as high as 20 per cent. of the cases. In the 1907 New York epidemic the youngest patient reported was two weeks old. The most susceptible age is from the eighteenth month to the sixth year. Males are affected more frequently than females.

**Transmission.**—Recent advances in our knowledge of the etiology and pathology of anterior poliomyelitis date from the work of Landsteiner and Papper in 1909. They succeeded in inoculating monkeys intraperitoneally with material obtained from a fatal case of the disease in a child. Knoepfelmacher also succeeded in producing poliomyelitis in a monkey by the inoculation of human material, but these workers were not able to transmit the disease from monkey to monkey. Flexner and Lewis succeeded in doing this without difficulty, using the intracerebral method of inoculation and carrying their strains of virus through many generations. Flexner and Lewis were also able to transmit poliomyelitis to monkeys by means of subcutaneous and intravenous inoculation, though not in all cases were such experiments successful. On the other hand, intranasal inoculation in monkeys gives results that are always positive, while intraneural inoculation, as practised by Leiner and v. Weisner, is less uniformly successful.

The virus of poliomyelitis is regularly present in the central nervous system, and less frequently in the tonsils, nasopharyngeal mucous membrane, and mesenteric lymph-nodes. It has not been found in the large viscera or in the blood. The spinal fluid from a human case of poliomyelitis is capable of producing the disease when inoculated into a monkey.

The virus resists freezing for a period of forty days, and drying for seven days, but becomes inert after exposure to 45° to 50° C. for half an hour.

<sup>1</sup> Jour. Amer. Med. Assoc., 1913, lx, p. 362.

It has been pointed out that epidemics of poliomyelitis develop along the route of human travel. Flexner and Clark showed that stable flies may harbor the virus on their bodies for a period of at least forty-eight hours, and that it may remain in their viscera for the same length of time.

**Immunity.**—Flexner and Lewis proved that monkeys which have recovered from poliomyelitis are immune to further attacks of the disease. They further showed that the blood of these immune animals contains neutralizing principles. Netter and Levaditi demonstrated the presence of such neutralizing principles in the blood of an abortive case occurring in a child.

**Pathology.**—The lesions produced by the virus of poliomyelitis are naturally most marked in the nervous system, but they are present in other viscera as well. In the nervous system the gross lesions are not always very pronounced. They may appear in the spinal cord, pons, medulla, and cerebrum, and consist of congestion and minute hemorrhages, chiefly into the gray matter. The lesions of the spinal cord are not confined to the anterior horn. On microscopic examination the most marked lesions are found in the cord at the level corresponding to the most completely paralyzed muscle groups. In the gray and white matter of the spinal cord there are focal lesions consisting of edema, perivascular cellular infiltration, numerous hemorrhages, and degeneration of the nerve-cells and fibers. The anterior horns of the gray matter show more marked lesions than do the posterior horns, the nerve-cells being sometimes replaced by leukocytes. The cells in a segment are always unequally involved. Similar focal lesions may be present in the medulla, pons, and cerebrum.

The primary lesion seems to be in the meninges, which show perivascular infiltration with round cells, chiefly lymphocytes. The cellular exudate about the vessels, with their resulting partial destruction, leads to secondary lesions in the nervous tissue itself.

The intervertebral ganglia show infiltration with lymphocytes between the nerve-cells and fibers, and some ganglion-cells show degeneration and necrosis.

In other viscera the lesions consist of hypertrophy of the lymphoid tissue, including that of the tonsils, the thymus gland, the superficial and deep lymphatic glands, the small intestine, and the spleen. There are also minute focal necroses in the liver.<sup>1</sup>

**Cerebrospinal Fluid.**—The cerebrospinal fluid shows changes varying with the stage of the disease. The cell count is almost always increased, being highest during the early days of the attack, and falling off progressively as the attack goes on, reaching the normal in two weeks, or less. In the majority of cases the fluid shows lymphocytes and large mononuclear cells only, but the polymorphonuclear cells may amount to 90 per cent. of the total.<sup>2</sup> The globulin content is increased, more so during the second week than the first. It may remain above the normal for seven weeks or more but during the chronic stage of the disease it tends to fall to normal. The sugar content is not far from normal, ranging from 40 to 80 mgm. per 100 c.c.

<sup>1</sup> Flexner, Peabody, and Draper, Jour. Amer. Med. Assoc., 1912, p. 109.

<sup>2</sup> Draper and Peabody, Amer. Jour. Dis. of Child., vol. iii, 1912.

*Blood.*—The blood was studied by Peabody, Draper, and Dochez in 71 cases of poliomyelitis. In only one case did they find a leukopenia. In 70 cases there was a constant and marked leukocytosis, sometimes ranging as high as 30,000.

During the preparalytic stage the total leukocyte count may be normal, though there is a tendency toward an increase with more polymorphonuclears and less lymphocytes than during health.

During the first and second weeks of the disease the leukocytes vary from 12,000 to 24,000 with an average of 18,000. The polymorphonuclears are increased 15 to 20 per cent. and the lymphocytes diminished 15 to 20 per cent. Transitional and large mononuclear cells show no change.

The leukocytosis continues for weeks, the average of 9 cases in the seventh week having been 17,250 leukocytes.

The youngest children showed the highest leukocytosis and the largest number of polymorphonuclear cells.

*Nasal Mucous Membrane.*—Flexner and Lewis showed that the nasopharyngeal mucosa is a regular site of elimination for the virus of poliomyelitis in monkeys experimentally inoculated with the disease, and Landsteiner, Levaditi, and Pastia demonstrated the same method of excretion of the virus in a human patient dying during the acute stage of poliomyelitis. Flexner and Clark also found the virus in the tonsils or nasal mucosa of human cases, and Flexner has suggested that "the nasopharynx acts in human beings as the portal of entry of the virus into the central nervous system, as well as its source of dissemination to other human beings." In monkeys, and also probably in human beings, the virus may disappear from the nervous system and from the tonsils and nasopharyngeal mucosa in from eight to ten days after the onset of the paralysis, or it may persist there for three or four weeks. The observation of Osgood and Lucas, who found that the nasopharyngeal mucosa of monkeys was still infectious five months after the acute stage of an attack of poliomyelitis, would seem to be exceptional and to indicate that chronic carriers of poliomyelitis may develop.

*Types of Cases.*—For clinical purpose poliomyelitis may be divided into three types: the *abortive*, in which no paralysis occurs; the *cerebral*, representing the rare cases with resulting spastic paralysis; and the *bulbar spinal group*, which comprises all cases with lesions in the lower motor neuron, and flaccid paralysis.<sup>1</sup>

*Period of Incubation.*—From five to fourteen days is generally accepted as the period of incubation. This observation is based upon the results of clinical and laboratory investigations.

*Symptoms.*—As in all infectious diseases, the symptoms vary widely. In a great majority of the cases there are decided prodromal symptoms.

The most constant early symptom is fever. Usually there is a sharp rise of temperature, in some instances to 105° or 106° F. The duration of the fever is variable—from one day to a week. In some cases there will be a sharp, sudden rise and rapid fall. In a few there is slight temperature, and in others none at all. In two recent New York epidemics of 1907 and 1916 gastro-intestinal symptoms were very prominent in

<sup>1</sup> Draper, Peabody, and Dochez, Rockefeller Institute Reports, No. iv.

a large number of cases, consisting in vomiting and diarrhea or a sharp attack of vomiting. A peculiar feature observed has been that the severity of the gastro-intestinal symptoms has borne no relation to the degree of the resulting paralysis. Ordinarily the paralysis is not noticed until the third or fourth day of the prodromal stage. Pain and hyperesthesia are very prominent symptoms in many cases.

The nervous manifestations may be very urgent; thus convulsions, apathy and stupor are not uncommon and the cases may closely resemble those of acute cerebrospinal meningitis. In fact, such an error in diagnosis is frequently made. When bulbar involvement predominates there will be facial or ocular paralysis, disturbance of speech and deglutition, and paralysis of the respiratory muscles.

Eleven fatal cases in private work which came under the senior author's observation in the 1916 epidemic were of this type. In 3 cases the paralysis was limited to the bladder. One case was of the very unusual ascending Landry type. The feet were first involved and then the trunk, arms, and neck. The child recovered after a long illness.

Early in the disease, before the paralytic stage, the reflexes may be exaggerated. The paralysis appears from two to four days after the acute onset. It may involve an entire limb, or be limited to muscle groups irregularly distributed. The extent, degree, and permanency of the paralysis depend upon the severity of the lesion in the cord. Lesions in the lumbar enlargement are the most frequent and cause the greatest number of cases of paralysis. Involvement of the cervical enlargement causes the next largest number of cases. Wickman reported the distribution of the lesions in 868 cases as follows:

1. One or both legs.....	353
2. One or both arms.....	75
3. Combination of arms and legs.....	152
4. Combination of legs and trunk muscles.....	85
5. Combination of arms and trunk muscles.....	10
6. Trunk muscles alone.....	9
7. Paralysis of "the whole body".....	23
8. Ascending paralysis.....	32
9. Descending paralysis.....	13
10. Combination of spinal and cranial nerves.....	34
11. Cranial nerves alone.....	22
12. Localization of paralyses not given.....	60

In about one-half of the cases the paralysis is limited to the legs. The *cerebral type*, in which a differentiation is difficult, presents clinically a symptom-complex which distinguishes it from the foregoing. This condition has been designated *polioencephalitis* by Strümpell. The onset in these cases is with fever, convulsions, vomiting, strabismus, and coma. The reflexes are usually exaggerated.

Imbecility, epilepsy, and spastic paralysis may be the outcome. Cases are often designated as cerebral which strictly do not belong to this type. In view of the fact that the infection is general, cerebral symptoms are necessarily present in many cases. The fact that these manifestations promptly disappear means that no permanent lesions were present, and that the brain shared in the toxic systemic effects.

That there are many cases of poliomyelitis which do not pass to the

paralytic stage is the opinion of all observers who have seen many cases of the disease. In the epidemics of 1907 and 1916 several such cases came under our observation.

Prodromal symptoms were very urgent in 2 patients who developed slight leg weakness and absence of patellar reflex. Both recovered in three weeks. In two others, a boy and girl in the family of a physician, the prodromal symptoms were rather mild and both developed a slight paralysis of short duration.

Wickman believed that over 25 per cent. of the cases belong to this, the so-called abortive type. There is no apparent distinction to be made between the symptomatology of the abortive cases and those that go on to the development of paralysis. Muller<sup>1</sup> believed that the abortive cases outnumbered those of paralysis. This view receives striking support from the recent demonstration of typical visceral lesions, indicating that there is a general systemic infection. With such pathologic findings, symptoms such as fever and malaise are reasonably to be expected. It may be that the abortive cases are those in which this general process is present, but in which the nervous system has been spared. Netter and Levaditi<sup>2</sup> demonstrated that the serum of abortive cases neutralizes the virus *in vitro*, just as does the serum of the patients that develop paralysis. It is quite probable that in the past many of the abortive cases have not been recognized, and in certain cases at least, the apparent immunity of adults may be dependent upon such a previous, unrecognized attack.

That the neutralizing substance in the blood may persist for a long period following an attack of the disease, and probably immunity be present as well, is shown by the case of a man who had been paralyzed thirty years before, and whose serum still protected a monkey from the virus.

**Course.**—Following the prodromal symptoms, flaccid paralysis, loss of knee-jerk, and atrophy appear. The paralyzed part becomes smaller than the corresponding limb or muscle group. The limb becomes cooler than the normal. Subluxation of a joint, due to relaxation of the ligaments, is not an uncommon occurrence in cases in which there is extensive paralysis.

**Electric Reactions.**—During the onset of the disease the electric irritability of the affected muscles and nerves is increased. After two or three days, however, these nerves fail to respond to stimulation, and the paralyzed muscles contract only under the galvanic current, showing the typical reaction of degeneration (an anodal opening contraction greater than the cathodal closure contraction). Galvanic irritability in the paralyzed muscles may be increased for several months, but thereafter diminishes, and after a year or more disappears.

**Prognosis.**—The prognosis in this disease must cover not only the mortality, but the resulting permanent paralysis as well. The mortality varies with epidemics; roughly, it may be said to range from 5 to 20 per cent. The younger the child, the less the danger to life is a rule borne out by experiences in many epidemics. The disease is more fatal after the fifteenth year. In a Springfield, Mass., epidemic, 7 patients were over fifteen years of age. Of these, 3 died. In the fatal cases death usually takes place by the fifth day.

<sup>1</sup> Draper, Peabody, and Dochez: Rockefeller Institute Monograph, No. iv.

<sup>2</sup> Compt. rend. Soc. de biol., 1910, lxviii, 617.

Prognosis as regards permanent paralysis is most difficult. Cases with very severe prodromal symptoms may have no permanent effects. The degree of damage depends upon the severity of the lesion in the cord, and this is impossible of demonstration. Patients whose paralysis was complete have made perfect recoveries, and other cases of similar nature have been followed by permanent residual paralysis.

*Illustrative Case.*—A child of eighteen months had complete paralysis of the neck muscles and all four extremities. In this case the outlook apparently was hopeless, and yet the child made a perfect recovery.

Permanent paralysis may follow very mild prodromal symptoms.

The prognosis is further influenced by the possibilities of continued treatment. Many cases admit of much improvement through properly directed management continued over long periods. Among 530 cases collected by Wickman, 56 per cent. were paralyzed, 44 per cent. cured after eighteen months. In Massachusetts there were 16.7 per cent. of complete recoveries.

That the disease is communicable by personal contact was definitely apparent during the epidemic in this section.

*Illustrative Cases.*—There had not been a case in a certain New England village for twenty-five years. Two children, aged three and six years, came to the village from an infected section. Both became ill with digestive disorders and fever on the day of their arrival. The three-year-old girl was kept in her room and later developed paralytic symptoms. The older child was ill about twenty-four hours, presenting a typical abortive case. Among the children who associated with her, one, a native, after six days developed a fatal poliomyelitis.

**Treatment.**—During the acute stage of the involvement of the cord our efforts count for little. We order that the child be kept quiet in bed, that a laxative be given, and that he receive light, easily digested nourishment; and then, so far as the immediate conditions are concerned, we have done our little, but our all. The writer has used the bromids and ergot and urotropin and the iodids internally, and ice-bags and blisters over the spine at the site of the lesion, and is yet to be convinced that they are worth the indigestion and discomfort they are apt to occasion. That the disease is due to an infection is now proved, and in a given case our hope must be that the infection will be mild in character. The outcome is determined largely by the severity of the infection and by the resistance of the child.

*Human Serum.*—The intraspinal use of human serum from those who have recovered from poliomyelitis has its advocates. Our own observations do not warrant an endorsement of this form of treatment.

*Later Treatment.*—From ten days to two weeks after the acute stage has passed our efforts should be directed toward maintaining the nutrition of the affected muscle or groups of muscles. This is to be done by mechanical means, warm baths, electricity, and gymnastic exercises.

The beneficial action of electricity consists largely in exercising the muscles no longer under voluntary control, and thus increasing their circulation and nutrition. The immediate object of the electricity is to induce contraction of the muscles. Either the faradic or the galvanic current may be used. The faradic should first be tried, and if to this

there is no response, the galvanic should be used. Sitzings of five to fifteen minutes may be desirable, depending upon the age of the child and the duration and extent of the lesion. The longer the duration of the disease, the longer should be the sittings. Once daily the parts should be massaged by one skilled in the work. When such a person is not available, the mother or nurse may undertake the systematic manipulation of the affected muscles by kneading and rubbing. Gymnastic exercises are unquestionably of very much value, but must be carried out over a long period of time. Children showing marked atrophy and paralysis and who promise little, often show surprising improvement, and restoration of function under properly directed exercises and manipulative treatment.

The further management is orthopedic, and consists in the prevention of deformities by the use of splints and braces, and their correction by tenotomies and tendon transplantation.

*Quarantine.*—That the disease is spread largely through undiagnosed abortive cases is unquestionable. Quarantine of all suspected or exposed cases should therefore be absolute. Furthermore, every child who develops an active illness with fever and gastro-intestinal disturbance during an epidemic should be quarantined, together with those children with whom he has previously associated.

### MULTIPLE NEURITIS

Multiple neuritis or polyneuritis is an acute inflammatory disease of the peripheral nerves, degenerative in character, and usually symmetric in distribution.

*Etiology.*—While the great majority of cases observed in children follow diphtheria this disease is by no means the only cause. The neuritis may be due to various toxic agents, bacterial and of other derivation, producing inflammation and degeneration of the peripheral nerves. Among possible causes, other than diphtheria, are malaria, the exanthemata, grip, pneumonia, erysipelas, and typhoid fever. The toxins of the micro-organism causing the infectious disease are responsible for the nerve lesions far more often than is the organism itself.

Pronounced cases in two brothers followed very severe scarlet fever.

Lead, phosphorus, arsenic, and alcohol as possible causes are to be kept in mind. Lead in children is a very unusual cause. Arsenic, phosphorus, and alcohol, however, are drugs used extensively during child life and should always be considered as possible etiologic factors. Citations will be found in pediatric literature calling attention to cases in which all these substances have been the means of causing multiple neuritis. Many mild cases of neuritis in children, following exhaustive diseases with prolonged toxemia, are doubtless overlooked, the prolonged time required for the return of muscle power in the arms and legs after disease being attributed solely to muscle weakness.

*Diphtheria.*—Every child with diphtheria should be watched and treated as if diphtheric paralysis were expected. It has occurred to some extent in 9 per cent. of the senior author's cases.

**Pathology.**—The nerves affected may show both interstitial and parenchymatous changes. Early in the disease there is a congestion of the nerve-sheaths, and multiple hemorrhages have been found in them. Later in the disease the changes are those peculiar to degeneration in nerve structures.

**Distribution of the Lesion.**—A peculiarity of the lesion is that the further away the peripheral nerve structure is from the parent cell, the greater is the susceptibility of the nerve to the influence of the toxic agent. The anterior tibial group, the soft palate, and the muscles of deglutition are most frequently involved.

**Sensory Effects.**—Sensory disturbances in children are not so prominent as the neurologist would have us believe, for the reason, possibly, that he usually sees only the more severe cases.

Quite a number of mild cases have been observed in which there were sensory disturbances and a diminished patellar reflex following lobar pneumonia with high temperature, and also after severe scarlet fever.

**Symptoms.**—The symptoms are variable, depending upon the parts particularly involved. If the extremities or the neck muscles are affected, a careful observer will notice a gradual loss of power. The head is held erect with difficulty. The child is timid and refuses to walk. Usually there are a few falls which occasion the timidity. The child, if old enough, complains of weakness in the legs. In some cases there is nothing more than a limp to indicate the disease. Pain may be present, but has been of unusual occurrence in our cases. The reflexes may be diminished or absent. The characteristic foot-drop and wrist-drop are present in severe cases.

Cases following diphtheria are particularly prone to paralysis of the muscles of deglutition. The child attempts to swallow, and the food returns through the nose. Deglutition may be interfered with to the point of impossibility of swallowing. There may be paralysis of the pharynx and larynx. Infrequently the muscles of the extremities are affected. The child may not be able to walk or sit upright, or even to support the head. It is the rule that if the heart is to be attacked, signs indicating heart weakness will appear early—soon after the paralysis of other parts is apparent, or even as an earlier symptom. The first warning is the heart's irregularity, and this may be the only evidence of its involvement. Cases in which the heart has been very rapid or slow have been reported by other observers. In personally observed cases the heart has not been particularly rapid, neither has it been slow. It is irregular in that for ten seconds there may be 10 beats and during the next ten seconds perhaps twice this number. Pronounced irregularity may continue for two or three weeks.

**Illustrative Cases.**—A boy six years of age had a very mild attack of diphtheria, not of sufficient severity (in the opinion of his physician) to necessitate his remaining in bed. Two weeks after the onset of the attack, at which period he came under the writer's care, there was marked paralysis of the soft palate and pharynx which rendered swallowing most difficult. In spite of energetic treatment with strychnin hypodermically, the paralysis soon involved the larynx, the masseters, and the muscles of all the extremities. Fortunately neither the heart nor the diaphragm was involved. There was a constant flow of saliva, which at times entered the trachea unimpeded, causing severe paroxysms of coughing. In order to prevent this the legs and trunk

were elevated, the head being made the most dependent portion of the body. Swallowing was impossible, and the patient was given by gavage, every six hours, completely peptonized milk, whisky, beaten egg, and strychnin. The boy made a complete recovery, but required three months to accomplish this.

In the case of another patient, fifteen months of age, gavage was practised at six-hour intervals for five days before food could be swallowed.

**Electric Reactions.**—The responses induced are exceedingly variable, depending on the degree of degeneration in the nerves and on the variations in this process during the progress of a case. Early in the disease both galvanic and faradic irritability may be increased. Faradic responses then diminish, and though galvanic excitability is usually increased temporarily, there is ultimately a more or less complete reaction of degeneration. Only in the most severe cases, however, is the galvanic response completely lost.

**Prognosis.**—Complete recovery is the rule if there is no cardiac or respiratory involvement, although several weeks or months may be required to bring about perfect recovery.

Few cases of diphtheric origin recover completely under eight weeks.

Cases showing only a slight degree of heart involvement are never free from danger.

*Illustrative Case.*—A girl, four years, apparently well, was admitted to the hospital with postdiphtheric paralysis of both legs, sufficient to prevent walking. The child, while resting on her back, dropped a top to the floor. She turned over and attempted to reach to the floor for the top and expired. The heart had previously shown some irregularity, and the child had been placed under close observation, which was momentarily withdrawn.

**Diagnosis.**—The diagnosis is readily made through the multiple symmetric distribution of the paralysis, the impairment of or complete loss of function without impairment of sensation, and finally the disturbed respiration and cardiac irregularity.

**Treatment.**—*General Measures.*—The treatment of postdiphtheric paralysis will be considered separately. In other forms of multiple neuritis the management is largely palliative, as there is a strong tendency to spontaneous recovery in four to eight weeks from the onset. In cases due to the use of alcohol or some other drug, the elimination of the exciting cause will usually be followed by recovery. In those cases due to the toxemia of preceding disease, time and good care are usually all that will be required to effect a cure. If pain is present, the most relief is afforded by heat. The affected limb may be bound in thick layers of cotton-wool.

**Drugs.**—Salicylate of soda and iodid of potash are not to be given to young children. They produce no appreciable effect, except possibly a disturbance of digestion and a lessening of the appetite. Should the pain be sufficient to interfere with sleep, bromid of soda may be given in doses of 8 to 12 grains for a child of five to ten years of age. This is best given at bedtime and should be repeated but once. In using hypnotics for children, one drug should not be continued longer than three days.

Codein is a satisfactory sedative for a child in case the bromid does not suffice. Between the fifth and tenth years from 1/10 to 1/6 grain of codein may be given at bedtime and repeated once after an interval of three hours.

As a tonic for a patient from five to ten years of age a valuable combination of drugs is the following:

R. Strychnine sulphatis.....	gr. $\frac{1}{4}$
Extracti ferri pomati.....	gr. x
Quinine bisulphatis.....	5j
M. div. et ft. capsulæ no. xxx.	
Sig.—One after each meal.	

If constipation is present or should result from the administration of iron, from  $\frac{1}{3}$  to  $\frac{1}{2}$  grain of extract of cascara may be added to each capsule. The capsules are to be given for ten days, followed by cod-liver oil for five days. The oil should be given after meals. At the end of the five days the tonic capsules are to be repeated, and in due time followed again by the oil. This method may be followed as long as is thought necessary.

*Convalescence.*—The patient should have the benefit of an outdoor life as early as possible. Electricity has not been necessary in our cases, nor has the use of orthopedic appliances been required. Massage may be used with advantage after subsidence of the acute symptoms. It should be given by one skilled in the work.

**Treatment of Multiple Neuritis After Diphtheria.**—Cases following diphtheria require particular mention because of the danger of involvement of the heart, muscles of deglutition, and of respiration. If, after ten days from the onset of paralysis, there is no evidence of cardiac involvement, it will probably not develop later, although this is by no means certain.

Mixsell and Giddings<sup>1</sup> reported 8 fatal cases of diaphragmatic paralysis out of 4259 cases of diphtheria. In the cases of phrenic paralysis with one exception the diphtheric exudate had been extensive and the antitoxin with one exception not given until after the third day of the diphtheria. The average time of onset of the paralysis was thirty-nine and a half days after the beginning of diphtheria. The cases developing paralysis of this type terminated fatally within an average period of thirty-six hours. *Prolonged absolute rest for a period of several weeks is always indicated for patients receiving antitoxin late in diphtheria.*

*Rest.*—Should the heart become involved, as shown by irregularity or attacks of fainting or nausea, absolute rest in the recumbent position is important. The patient should be constantly under the eye of an attendant and should not be allowed to turn over in bed or raise his head without assistance.

*Medication.*—A hypodermic syringe containing 1/100 grain of strychnin should be in readiness throughout the entire illness and well on into convalescence. Camphor in the dose of 1½ grains in capsule may also be kept at the bedside, ready for hypodermic use.

In these cases we rarely have to deal with children under eighteen months of age, so that in the consideration of doses only children over one year of age will be referred to. To a child from one to two years old 1/300 grain of strychnin may be given at three-hour intervals; from two to four years of age from 1/200 to 1/150 grain at three-hour intervals. After the fourth year 1/150 to 1/100 grain may be given similarly. When

<sup>1</sup> Jour. Amer. Med. Assoc., vol. 77, No. 8, 590, August 20, 1921.

there is marked rapidity of the heart's action with irregularity, and restlessness, in those under three years of age, from 1 to 2 drops of tincture of strophanthus may be given with 1/15 to 1/10 grain of codein, and repeated at two-hour intervals. After this age 1½ to 3 drops may be given with 1/10 to 1/6 grain of codein at two-hour intervals. The codein is to be discontinued as soon as the restlessness ceases. For those in whom there is simply paralysis of the muscles of deglutition or of the extremities, small doses of strychnin will be all the medication required, from 1 300 to 1 200 grain three times daily being sufficient.

*Gavage.*—Troublesome obstacles in the management of cases in which there is marked involvement of the muscles of deglutition, and the palate, pharynx, and larynx, are the difficulty in feeding the patient and the danger of his aspirating food and mucus as a result of paralysis. For such patients gavage (p. 853) may be used with much benefit, 6 to 10 ounces of food being introduced into the stomach at four- to six-hour intervals. In using the so-called forced feedings it is well to give as large feedings at one time as possible, as the gavage is always resisted by the patient. In the cases in which the aspiration of fluids and mucus into the larynx is a troublesome or dangerous factor, the trunk should be elevated and the head lowered.

### FACIAL PARALYSIS

Paralysis of the facial nerve is not of infrequent occurrence in the very young and may result from forceps pressure at birth or from pressure exerted by the bony parts of the pelvic outlet. In later infancy or childhood facial paralysis may be the result of trauma caused by operative manipulations, or may be of rheumatic origin, or due to cerebellar disease, or to exposure to cold. In one patient the paralysis was attributed to sitting by an open window in a railroad car on a cold day. The nerve, in its outward passage through the fallopian canal, may become diseased from the presence of a purulent otitis media. This is probably the most frequent cause of facial paralysis. It may also be caused by poliomyelitis. During the 1916 epidemic a vast number of cases showed facial paralysis—many without other signs of paralysis. In other cases the facial paralysis was associated with that of other parts.

*Prognosis.*—The prognosis depends largely upon the cause of the paralysis. Cases due to exposure to cold, and rheumatism, and those in the newborn that are due to birth trauma usually terminate in recovery. Cases resulting from section of, or other injury of the nerve, through accident at operation, likewise almost always have a satisfactory outcome.

The unfavorable cases are those due to brain disease such as meningitis or tumor, or to severe injury, such as fracture or caries of the temporal bone.

In facial paralysis resulting from ear inflammation the prognosis is less favorable than in ordinary cases because of the fact that the involvement of the nerve is apt to be of a destructive type. Cases showing a complete reaction of degeneration require months for recovery. If this reaction, however, is not complete, recovery may occur in a period of weeks.

**Treatment.**—The management depends entirely upon the cause of the paralysis. If the condition is due to cerebral disease, but little is to be expected from treatment. If the paralysis is due to an otitis media, surgical procedures, such as establishing a free drainage from the cavity of the middle ear, followed by frequent hot irrigations, should be employed. If these are ineffective, the mastoid should be opened and the cavity drained posteriorly. When the functional activity of the nerve is delayed, electricity may be brought into use in the manner indicated below. Cases in which rheumatism is supposed to be a factor should be given the benefit of antirheumatic treatment by the use of the salicylates (p. 737). In the cases due to cold or trauma there is a strong tendency toward recovery without treatment.

It is difficult to judge of the value of such a therapeutic measure as electricity; but the effect of exercising the paralyzed muscles and stimulating nerve conduction by its use must be of some service. If the electricity is used, five-minute daily sittings are all that are necessary. The faradic current should be employed if it produces sufficient muscle response; if not, the interrupted galvanic current.

#### ERB'S PALSY (OBSTETRIC PARALYSIS)

This disease is due to a traumatic neuritis caused by an injury of the brachial plexus during labor.

**Lesion.**—The injury may be very slight, causing but a temporary paralysis, or very extensive, causing subsequent degeneration of the nerve structure. The essential lesion in Erb's palsy is an injury of the fifth and sixth cervical nerve-roots near their junction on emergence from the spinal cord. This injury may involve rupture, laceration, or bruising of the nerves, and occasionally hemorrhage between the fibers. In typical cases the seventh and eighth cervical nerves are not injured, but occasionally these also may be damaged. The muscles principally affected by the paralysis are the deltoid, biceps, brachialis anticus, supinator longus and supinator brevis, the spinati, and coracobrachialis. The pectorals, latissimus dorsi and triceps may be partially affected. In 400 of 460 cases reported by Sever<sup>1</sup> the paralysis was of the upper arm type.

Under the influence of the action of unparalyzed muscles the head of the humerus in many cases becomes secondarily displaced backward from its socket, so that the arm is abducted on the scapula, flexed forward, and rotated inward. This condition may be confused with true congenital dislocation.

**Diagnosis.**—The chief point in the diagnosis is that one arm alone is involved. Cases of bilateral involvement are extremely rare. In differentiating this form of paralysis from cerebral palsies it will be noted that in Erb's palsy there is a flaccid paralysis with some degree of atrophy, there is never spasticity, and the mentality is normal. After a few months the affected limb becomes smaller and much softer than the unaffected arm. Owing to the location of the muscles involved and because of the paralysis of the supinator group, the arm is often rotated inward, throwing

<sup>1</sup> Amer. Jour. Orthop. Surg., August, 1916.

the palm of the hand outward and backward. Owing to paralysis of the extensors, due to involvement of the musculospiral nerve, the fingers and thumb are in a more or less permanent condition of flexion-fixation.

Exceptionally the deformity caused by a birth fracture may simulate that of Erb's palsy.

**Prognosis.**—In the main the prognosis is favorable, but not as favorable, from our observation, as the literature would lead us to believe. In fact, a guarded prognosis should always be given. A case involving fracture of the humerus with complete paralysis underwent complete recovery in three months. Only partial recoveries have occurred in other instances, and in still others the lesion has been of such a nature as to make recovery impossible. We may safely say that all the subjects improve and that they may recover entirely, but we are not in a position to promise any outcome in a given case. Improvement should not be despaired of even after several months have elapsed. Exceptionally the improvement has continued to the eighth and tenth year. In a few cases the paralysis and deformity are permanent. If there is complete paralysis after one year one may safely assume that the paralysis will be permanent.

Sachs has stated that even in the event of complete paralysis, recovery may be looked for in the cases showing a slight response to faradism, in two or three months. When there is no faradic response, but reaction to the galvanic current, the restoration of power may be expected in six months. In those cases in which there is no galvanic or faradic response, a year or two may be required before the arm is normal.

**Treatment.**—The atrophy and contractions which develop are determined largely by the extent of the injury, and to a lesser degree by the treatment. During the first three weeks in lifting and handling the infant the arm should be protected from other injuries, such as may take place in bathing and the usual manipulation necessary in the care of the baby. After this time massage of the entire arm and shoulder with lanolin should be practised at least twice a day, from ten to fifteen minutes at a time. After two weeks electricity may be used for a few minutes each day. If the child can bear it, the faradic current answers best. In cases in which there is no response to faradism, the galvanic current should be used. Under massage and electricity the improvement in the arm is often most satisfactory.

To correct deformity the arm should be held in abduction and outward rotation with the forearm held in supination by a suitable splint. If the humerus is dislocated the condition must be corrected, if necessary under anesthesia; and the correct position must be maintained long enough to prevent recurrence of the dislocation.

The degree of improvement is dependent upon several factors, the chief one of which (the extent of the nerve injury) is in every case uncertain.

In the more severe forms of obstetric paralysis in which the lower arm or the whole arm is affected, provided a reasonably long period has elapsed under proper care without improvement in the muscles, an operation upon the brachial plexus with excision of indurated tissue and approximation of the nerve ends by sutures is to be undertaken. Sharpe<sup>1</sup>

<sup>1</sup>Jour. Amer. Med. Assoc., March 18, 1916.

has recommended this procedure in cases with complete paralysis at the end of one month.

Such a degree of paralysis means that there has been an extensive injury and tear in the plexus. In such an instance there is bound to be an impaired arm. The early operation is advised in order to forestall the formation of large masses of fibrous tissue. The earlier the anastomosis of the nerve roots, the more perfect the union of the torn nerve structures and consequently the better the ultimate result.

An important feature in the management of these cases is the prevention of deformity through contractures. This may be accomplished by the use of suitable orthopedic appliances.

### FRIEDREICH'S ATAXIA (HEREDITARY ATAXIA)<sup>1</sup>

Friedreich was the first to describe this affection and establish it as a clinical entity. The designation, "hereditary ataxia," is faulty for the reason that heredity does not necessarily enter into consideration. This disease, however, shows a tendency to family selection.

**Definition.**—"A slowly progressive disease of the spinal cord occurring in late childhood, characterized clinically by loss of equilibratory control, ataxia affecting progression, nystagmus, and peculiar deformities, particularly a form of talipes equinovarus or pes cavus. The disease is dependent anatomically upon primary degeneration of the dorsal columns and spinocerebellar and pyramidal tracts.

**History.**—"Following Friedreich's description, Brousse, a Frenchman, gave the name of the former to the disease, and later Marie differentiated the cerebellar form, typically combining onset after the twentieth year, increased knee-jerks, ocular paralyses, and optic atrophy. Schultze, in 1877, showed that the form described by Friedreich was unrelated to locomotor ataxia and was due to inherent defective cord development.

"Typical hereditary spinal ataxia of the type first described is comparatively rare. Schoenborn<sup>2</sup> in 1901 could collect only about 200 positive cases, and later made the estimate of another possible 200 cases in the next fifteen years. Griffith<sup>3</sup> reported 143 cases in 1889, but believes that some of these cases might properly fall into a different category. He cites the record of the family reported by Carre,<sup>4</sup> in which the grandmother, 9 of her children, and 7 children of one affected daughter were all victims of the disease.

**Etiology.**—"Fundamentally there is in the spinal cord a lack of development, which is inherited indirectly, oftener than immediately, from either parent. The degeneration which occurs is superimposed upon the primary abiotrophic defect. Schoenborn found the disease to be familial in 114 of 200 cases. Approximately 60 per cent. of cases observed have occurred in males."

Gowers refers to 65 cases occurring in 19 families. The number of

<sup>1</sup> Quoted portions from Friedreich's Ataxia, Graves, Arch. of Pediatrics, November, 1921.

<sup>2</sup> Burr, Text-book on Nervous Diseases.

<sup>3</sup> Transactions, College of Physicians, Phila., 1888, x, 196, and Diseases of Infants and Children.

<sup>4</sup> De l'ataxie locomotrice progressive, 1865, 65, 248.

cases in one family was as high as 10. Gowers finds the sexes about equally divided as regards liability. Sachs, in a wide experience, has never seen a case in a girl.

Kerley observed the disease in 2 boys aged four and six years whose family history had been perfect.

"The incidence is most commonly between the ages of five and fifteen, but cases have been reported between the ages of two and four, and occasionally after maturity. Consanguinity, alcoholism, syphilis, and insanity have been noted in ancestors of the patients, but neuropathic ancestry is by no means always a discoverable factor. The first symptoms of ataxia often follow an acute illness or one of the infectious fevers."

**Pathology.**—Neurologists agree that the pathology of Friedreich's disease is not well understood. Sachs states that "one fact is indisputable, in microscopic examinations a sclerosis of the spinal cord is found involving at different levels or at one and the same levels various systems of the cord. The sclerosis affects most frequently the posterior columns or the lateral columns, or both together, and hence the symptoms vary between those of a pure posterior spinal sclerosis and those due to a posterior lateral sclerosis, resembling the symptoms of the ataxic paraplegia of the adult."

"A striking feature remarked by many observers is the small caliber of the spinal cord. There is sclerosis of the dorsal columns of Goll and Burdach, typically also of the crossed pyramidal and spinocerebellar tracts and usually involvement of the columns of Clarke and Gower. In cases of the Marie type there is likewise atrophy of the cerebellum, while even in Friedreich's ataxia atrophic changes in the cerebellum have been reported. In most instances, however, the cerebellar changes have been limited to hypoplasia. Secondary changes in the dorsal roots are common. The variability of the symptoms noted has been easily explained by the fact that even in extreme sclerosis normal fibers persist and degenerations in different portions of the cord may or may not be simultaneous. The cerebrum is apparently unaffected."

**Symptoms.**—"Walking is early interfered with and the child stands with difficulty. The first awkwardness in gait frequently makes its appearance after an acute illness or a period of physical depression. Gradually the steps become unsteady, the feet are placed wide apart, and there is an increasing tendency to stumble. Checking a quick run and wheeling about in the reverse direction calls for excessive movements of the arms to maintain balance or gain direct support from some stationary object at hand. In standing the trunk is held forward, the legs and arms and even the hands are held slightly flexed, and there may be oscillatory movements of the head and trunk. As the disease advances the gait becomes more staggering, but does not include the throwing out movements of the feet characteristic of true tabes. The knee-jerks may be present early in the disease and are occasionally exaggerated, but usually become lost within a year. There is contracture of the posterior tibial muscles and hyperextension of the large toes, resulting in talipes equinovarus, one of the most reliable signs of the development of the condition. In cerebellar ataxia also this sign may exist. In the later stages, ataxia

of the upper limbs, paraplegia, claw hand, scoliosis, and kyphoscoliosis supervene; and nystagmus and scanning speech are added."

Inco-ordination in the use of the arms is at first not unlike that in chorea. Attempts at a concise volitional act with the upper extremities—such as writing, bringing the ends of the index-fingers together, or placing the tips of the fingers on the tip of the nose—result in hesitancy, tremor, and imperfection in the act attempted. In fact, the act can be accomplished only with much effort and after several attempts if at all.

There is usually a positive Babinski sign. Romberg's symptom is variable. It was present in the 2 boys observed by Kerley. Characteristically control of bladder and rectum are unimpaired. Sensation is not greatly interfered with. The eye changes are not important. Nerve atrophy does not occur and the Argyll Robertson pupil is absent.

The patient is mentally slow and diffident. There is an entire loss of confidence, and this is stamped on the countenance and is manifested in every voluntary act. The child hesitates and speaks slowly, as though ideas were hard to formulate into words.

"The *course* is extremely slow and attended by periods when no added symptoms are noted and good general health may veil the gradual retrogression in the nervous system, thus giving the impression of improvement. Five to ten years may elapse before the patient is bedridden, and as many more before death ensues from pneumonia or some intercurrent disease. From a review of the description it is difficult to foretell with any accuracy the sequence of the symptoms in a given case."

"The *pathogenesis of the individual symptoms* calls for considerable explanation which is not adequate even in some of the best neurologic text-books. 'The ataxia in its spinal components is to be traced back to the process in the posterior columns; in its cerebral components, to the degeneration in the lateral cerebellar tracts.'<sup>1</sup> When the cerebellum is not properly informed as to the status of muscles dealing with co-ordinated action, owing to improper or defective transmission of impulse through the degenerated spinocerebellar tracts, ataxia is the result. The lack of marked impairment of sensation is explained by the facts that pain, temperature, and pressure are not dependent on the posterior columns for their transmission, whereas sensations giving an idea of position and degree of contraction of muscles are thus conveyed, the result being ataxia without paralysis. The Babinski reflex is explained by involvement of the pyramidal tracts; and the loss of deep reflexes, by degeneration of the lower sensory neurons. The nystagmus, likened to intention tremor, and the dysarthria have been ascribed to degeneration in the brain stem."

**Prognosis.**—"The outlook in a given case for many years of life is good. The outlook for health permitting efficiency is, of course, practically hopeless."

**Diagnosis.**—"This is possible even without a family history if one reviews the following tabulation in connection with thorough observation of the suspected case:

<sup>1</sup> Burr, Text-book on Nervous Diseases.

*Friedreich's ataxia.*

Heredity.  
Onset at five to fifteen years.  
Ataxia of lower limbs first.  
Loss of knee-jerks within one year.  
Babinski.  
Nystagmus.  
Pes cavus, claw-hand, scoliosis.

*Hereditary cerebellar ataxia.*

Onset later.  
Ataxia of all limbs.  
Reflexes increased.  
Optic atrophy.  
Rarely deformity of foot or spine.

*Juvenile tabes dorsalis.*

Early adult life.  
Lightning pains and girdle sensations.  
Early loss or diminution of reflexes.  
Ptosis.  
Pupillary signs.  
Bladder and rectal symptoms.  
Stigmata of syphilis.  
Positive Wassermann.

*Multiple sclerosis.*

Early adult life.  
Ataxia spastic.  
Intention tremor.  
Increased reflexes.  
Nystagmus, scanning speech.  
Optic atrophy. Pallor of optic disks.

*Multiple neuritis.*

History. Ataxia. Sensory and motor symptoms."

**Treatment.**—"Aside from measures to maintain good general health there is no treatment. Education in muscular movements to compensate for the ataxia, as in the treatment of tabes by the Fraenkel method, may be of some avail."

## ACUTE INFECTIVE MENINGITIS

Acute meningitis, as its name implies, is an acute inflammation of the meninges covering the brain and cord.

**Etiology.**—Acute meningitis may be either a primary or a secondary disease. The more common sources are suppuration in the ears, nose, and eyes, head injuries, and systemic infections with a bacteremia, such as typhoid, influenza, pneumonia, and infective endocarditis.

When primary, meningitis is usually due to the meningococcus or the pneumococcus. Meningococcus meningitis is considered under a separate caption (p. 610).

Cases of secondary origin are usually the result of the invasion of the staphylococcus. The streptococcus, colon bacillus, typhoid bacillus, and influenza bacillus may also be included in the latter group, the meningeal involvement being a complication or sequel of pneumonia, an intestinal infection or typhoid fever. Streptococcus or staphylococcus meningitis is often a complication of middle-ear, mastoid, or sinus disease.

**Pathology.**—The changes occurring locally in and about the brain depend on the character and source of the infection. In ear infections the lesions are often unilateral and accompanied by sinus thrombosis. In the majority of the other cases the vessels of the pia are congested and give origin to small hemorrhages, and the surface of the brain is covered with seropurulent or fibrinopurulent exudate. The convolutions are flattened to a degree depending on the amount of associated hydrocephalus. Accompanying cord involvement is the rule. The presence of a large amount of greenish-yellow exudate over the anterior portion of the cerebral cortex, with many fibrinous adhesions, is very characteristic of pneumococcus meningitis. In certain infective fevers, such as measles and scarlet fever, acute serous meningitis (p. 619) may occur.

In a private case due to the pneumococcus the anterior half of the brain cortex (see Plate I) was incased in pus.

**Symptoms.**—If the case is primary the onset may be sudden, with vomiting and convulsions, both of which may be repeated many times. Supervening upon the active manifestations there will be at first drowsiness, followed by stupor, from which the child can with difficulty be aroused.

The first indication of cerebral involvement is the drowsiness, stupor combined with irregular respiration, and irregular pulse. *A disturbance of the heart action is a very significant and early sign.* It may be irregular, intermittent, or it may be very rapid and regular. Repeatedly the heart rate has been observed as 140 to 180 a minute, with practically a normal temperature. Vasomotor disturbance indicated by the tache cérébrale may be an early symptom. In the infant a tense fontanel is one of our most valuable signs. The pupils are usually dilated symmetrically or unevenly, and show little or no response to light. Hyperesthesia and rigidity of the neck may be present. Swallowing is early interfered with.

Purposeless movements of the leg or arm are often seen when the symptoms of the disease are well marked. The leg or arm is raised and allowed to fall, this being repeated for hours at a time. An elevation of temperature is usually present. It may be high, low, or variable.

In the seven-month-old infant above referred to, whose brain is shown in Plate I, the first signs were a temperature of 102° F., a greatly distended fontanel, and stupor. The child died in three days.

**Diagnosis.**—The only positive information as to the nature of the infection is obtained by lumbar puncture; only in this way can a positive differential diagnosis between acute simple, tuberculous, and cerebrospinal meningitis be made.

In many severe diseases in which there is marked toxemia, symptoms closely resembling meningitis will be in evidence. In pneumonia, otitis media, the severe intestinal infections, and in heat prostration the cerebral symptoms so closely simulate those of meningitis that a positive diagnosis without lumbar puncture may be impossible. Before the advent of lumbar puncture most excellent clinicians diagnosed meningitis in cases which at autopsy showed no pathologic condition in the brain. We have known cases so diagnosed to recover too promptly to be a comfort to the attending physician.

**Differential Diagnosis.**—Acute simple meningitis, tuberculous meningitis, cerebrospinal meningitis, anterior poliomyelitis, acute epidemic encephalitis, and meningismus all show certain symptoms in common, sufficient to require a lumbar puncture with examination of the spinal fluid, in order that a positive diagnosis be made. In acute simple meningitis the fluid is usually turbid, and when allowed to stand, a considerable deposit of pus forms in the tube, bacteriologic examination of which determines the nature of the infection. The cells present in the fluid are almost exclusively polymorphonuclear leukocytes. In meningismus there are the signs of drowsiness, stupor, and perhaps hyperesthesia and immobility of the pupils, but no irregularity of the pupils, and rarely irregular respiration and distention of the fontanel. Partic-

PLATE I



*Pneumococcus meningitis.* (Dr T. W. Kilmer.)



ularly significant in such cases is the absence of signs of irregularity or slowness in the heart action. The characteristics exhibited by the spinal fluid in the diseases mentioned are detailed in a separate section (p. 623).

**Prognosis.**—The prognosis is most unfavorable. We have yet to see recovery in a case in which the diagnosis was proved by lumbar puncture. Occasionally such recoveries are reported.

**Treatment.**—The most one can do in acute simple meningitis is to nourish the patient and lessen his discomfort. We have no means of treatment that may be considered in any sense curative. By the use of repeated lumbar puncture we can in some cases make the patient more comfortable, and perhaps aid him to resist the infection. The pulse and the respiration improve, as well as the control of the nervous phenomena; the opisthotonos and the excessive hyperesthesia may be temporarily relieved. There is no rational ground, however, for expecting the withdrawal of the cerebrospinal fluid to be curative; nor may the injection of antiseptic solutions into the canal be expected to aid in controlling the disease.

*Lumbar puncture* (p. 821) may be practised as frequently as once in twenty-four hours, the frequency of such procedure depending, of course, upon the condition of the patient and the relief afforded. The use of lumbar puncture more frequently than once in twenty-four hours, as has been suggested by some writers, is not, however, to be advised. The amount of fluid to be withdrawn depends upon the pressure in the canal as indicated by the passage of fluid through the cannula, from 1 to 3 ounces being the usual amount withdrawn. Strict surgical precautions as regards asepsis should be observed in performing the operation. One dram of aristol in 1 ounce of collodion, applied with a camel's-hair brush, makes a suitable protective dressing after the withdrawal of the cannula.

**Warm Packs.**—The warm pack or warm bath at 105° F., by lessening the cerebral blood-pressure, may also assist in relieving the more active nervous manifestations. If the bath is used, the child should not be kept in it longer than three minutes. The hot pack is usually preferable. A large bath-towel or medium-weight flannel sheet is wrung out of water at 110° F., and wrapped around the child's body from the waist down. This is repeated at half-hour intervals for three hours, when, after a period of rest for an hour or two, the packs may be resumed.

**Diet.**—The proper nutrition of the patient with meningitis is often a matter of no little difficulty. The child may either refuse the food, or be unable to swallow. Nutrition by means of the rectum or colon may be of assistance for a few days, but cannot be relied upon for long periods for the reason that the parts become intolerant and the nutrient enemata are expelled. Feeding by means of gavage is always to be employed when other means fail. The younger the child, the more applicable this method. The feeding should not be attempted oftener than at four-hour intervals; usually, feeding every six hours suffices. Completely peptonized whole milk (p. 76) is usually given in quantities suitable for the age. After a few trials of gavage the patient may take the nourishment by the usual method, or the gavage may be continued.

**Sedatives** may be employed with a view to saving the strength of the patient. Morphin, codein, bromid of soda, or chloral may be given.

As morphin and codein increase the usual existing constipation, their use should be very temporary. The bromid of soda for the cases which may require the protracted administration of a sedative answers better than any other form of medication. To an infant under eighteen months of age from 2 to 4 grains may be given at intervals of two to three hours, according to the results. In case the nervous symptoms are very urgent,  $\frac{1}{2}$  to 1 grain of chloral may be added. Should administration by mouth be impracticable, the sedative may be given by rectum, by means of a rectal tube inserted at least 9 inches. In using the bromid and chloral in this way twice the amount of chloral and thrice the amount of bromid employed in stomach administration should be given. After the eighteenth month, from 1 to 2 grains of chloral and from 4 to 8 grains of the bromid well diluted may be given by the stomach, and repeated as often as may be necessary. In case the medication is to be given by rectum, it should be diluted with at least 4 ounces of water, and proportionately more given.

### TUBERCULOUS MENINGITIS

Tuberculous meningitis is one of the most fatal diseases of childhood. As its name implies, it is a tuberculous inflammation of the meninges. The frequency of the disease is due to the favorable field offered by the covering of the brain for bacterial growth and the wide dissemination of the tubercle bacillus. The rapid development of the brain, the birth weight of which is increased about four times during the first four years of life, necessitates rapid development and active work on the part of the blood-vessels and lymphatics. These, therefore, supply a favorable culture field for the invading organism.

**Age.**—No age is exempt. Our youngest patient was three months old. Between the first and third year the greatest number of cases occur. The disease is rare after the eighth year. We have seen a few cases between the twelfth and the eighteenth year.

**Pathology.**—This form of meningitis is usually secondary to tuberculosis elsewhere in the body, and is usually part of a general miliary infection. Among 413 fatal cases of tuberculosis in children, Shennan reported tuberculous meningitis in 184, or 44.5 per cent. In 77 of these cases the disease had spread from mediastinal glands; in 26, from abdominal glands; and in a small number, from an active pulmonary inflammation. Transmission is practically always through the blood. Miliary tubercles may be numerous on the walls of the blood-vessels of the pia mater, and over all surfaces of the cerebrum, cerebellum, and cord, but are usually most numerous at the base, between the peduncles. There may be more or less exudate of fibrin and leukocytes at the base. The spinal fluid is increased in amount and, owing to the closure of the foramen of Magendie by inflammatory exudate, the lateral ventricles become dilated. The ependyma may contain many miliary tubercles. Flattening of the cerebral convolutions may result from accumulation of fluid in the ventricles.

**Symptomatology.**—Tuberculous meningitis is variable in its early manifestations. Probably one of the earliest indications of the disease is a change in the disposition of the patient. A happy, easily pleased

child becomes cross and disagreeable, and may remain for days in this condition. In getting the history of a case we have repeatedly heard these symptoms mentioned.

*Illustrative Cases.*—A girl patient, three years of age, was in the habit of going to the park daily. On her return home, regardless of the street selected by the nurse, the child insisted on turning back and passing through another street. She was also very irritable and refused to play with other children. The mother had been in the habit of singing several songs to the child. The child selected one and would have no other. She was not content out of the mother's arms, and insisted that the song constantly be sung to her while awake. The mother became nearly distracted at the constant performances, and at this time, after three weeks of decided mental aberration on the part of the child, brought her for treatment. She died five weeks later from tuberculous meningitis.

In 2 cases the first symptom and the only symptom for two weeks was intense headache.

A boy fourteen years old who had occasioned suspicion of the existence of miliary tuberculosis because of unexplained fever of several weeks' duration suddenly complained of diplopia. Frank tuberculous meningitis of fatal issue rapidly supervened.

There may be vomiting without apparent cause, and if the vomiting is repeated one or more times on successive days and associated with other suggestive signs, it constitutes a symptom of no little value.



Fig. 111.—Facies of tuberculous meningitis, showing facial paralysis and strabismus. (Children's Medical Division, Bellevue Hospital, N. Y.)

Convulsions may usher in the disease. The convulsions are apt to be repeated several times.

Mental disturbance, diplopia, vomiting without apparent cause, convulsions, loss of appetite, constipation, restlessness at night, and night-cries belong to the earlier manifestations. After a week or perhaps two weeks of pronounced though indefinite signs the child becomes dull and apathetic, sleeps a great deal, and rapidly passes into a condition of semistupor from which he is aroused with difficulty. If roused he manifests extreme irritability. Hyperesthesia and exaggerated reflexes may be present early in the disease. With the progress of the case they often disappear. The fontanel in a young child early becomes tense and bulging—a very valuable sign.

Decided evidences of cerebral pressure soon make their appearance. The respiration becomes irregular. The pulse-rate is 60 to 80 instead of 100 to 120. At times the pulse will change very markedly and be-

come rapid for a few hours; as a rule, it is characterized by slowness and irregularity. Rigidity of the neck, slight opisthotonos, and spasticity of the extremities appear. During this time the child will usually swallow if food is given. In many cases there is an inco-ordinate, almost perpetual motion of the arm and leg on one side of the body. The pupils become sluggish, responding slowly to light stimulation, or fail to show any response. The pupils may be unequal. One pupil may respond to light, while the other remains stationary.

There is no characteristic temperature in tuberculous meningitis. The usual range is between 99° and 102° F. It may be higher or lower.

The blood usually shows a considerable leukocytosis ranging between 12,000 and 20,000, with a corresponding increase in the polynuclear cell percentage.

Very few cases of uncomplicated tuberculous meningitis occur, as mentioned before. The meningitis is usually associated with tuberculous processes elsewhere, which exert a controlling influence on the temperature.

*Later Symptoms.*—The coma increases. It is impossible to arouse the child. Liquid food placed in the mouth remains there or runs out at the sides. The breathing is labored. Cheyne-Stokes' respiration develops. The pulse becomes slower, intermittent, and irregular; and the child dies.

Regardless of the age, the signs and symptoms are very similar.

Occasionally one meets with fulminating cases with sudden onset and urgent symptoms of vomiting, high fever, rapidly developing stupor, and irregular pulse and respiration. Such cases are rare, and when they occur, are easily confused with those of meningococcus meningitis.

**Diagnosis.**—Early positive diagnosis is impossible unless the case is a very active one. With the development of pressure signs, certain phenomena appear which point very strongly to the nature of the disease.

Rigidity of the neck is usually present in some degree. When the child's head is raised from the pillow, the entire body may be elevated accordingly.

Fulness of the fontanel (in case the fontanel has not become closed) is always present in greater or less degree, and is a sign of much value.

Slow, irregular pulse, and slow, uneven respiration are symptoms of great diagnostic value. Rarely does a case pass through its various phases without showing these phenomena.

Drowsiness, gradually increasing, followed by stupor and coma, is a constant manifestation.

Unequal, inactive, usually dilated pupils will be found in cases well advanced. Strabismus, deviation of the eyes, and diplopia may develop earlier.

Repeated vomiting without apparent cause, in the presence of suggestive signs, supplies valuable corroborative evidence.

The abdomen is characteristically scaphoid.

The *Kernig sign* consists of an inability to extend the leg on the thigh when the thigh is flexed on the abdomen. This symptom is present in nearly all cases late in the disease.

The Babinski reflex and Oppenheim's reflex are of very little value;

if present, they corroborate other findings. Their absence means nothing. True, they may be present in a certain proportion of cases of tuberculous meningitis, but they are present in tetany and so-called tetanoid states from whatever cause, and they may also be present in brain injury and in spastic paraplegia due to birth trauma.

The temperature range is of no value in diagnosis for reasons already given. Optic neuritis is present in a majority of the cases late in the disease. Tubercles in the choroid will be found in many cases.

*Lumbar Puncture.*—A positive diagnosis can be made only by lumbar puncture (p. 821). Tubercle bacilli may be found in the spinal fluid in practically all cases of tuberculous meningitis, although it may be necessary to make more than one examination. In withdrawing the fluid, that which is drawn last should be collected for the examination. The test-tube, in which 10 to 15 c.c. of fluid has been collected, should then be allowed to rest at room temperature for twelve to eighteen hours when a delicate clot of fibrin will have formed in the fluid. The fluid is not to be agitated. The fibrin may then be removed and examined by the usual methods for the detection of tubercle bacilli. The spinal fluid shows lymphocytosis and the globulin test is positive. The spinal fluid sugar content is almost invariably below normal and in suspicious cases a low sugar content may be taken as strongly indicating tuberculous meningitis.

The appearance of the fluid withdrawn is suggestive, being clear or slightly opalescent in tuberculous meningitis, while in other forms of meningitis the fluid is usually turbid and cloudy.

In one case the tubercle bacilli were not found until the tenth spinal puncture was made. The child had all the usual symptoms of meningitis, and there were tubercle bacilli in the bronchial secretion; the examinations were, therefore, persisted in.

**Differential Diagnosis.**—The first problem in a given case is to decide whether there is a meningitis and whether the signs are such as to warrant further investigation. Such being the case, a differentiation as to the type we are dealing with is necessary, and here again lumbar puncture must be brought into use.

We may have a very active condition due to the tubercle bacillus which may be readily confused clinically with meningitis of the epidemic cerebrospinal type. On the other hand, we have seen several proved cases of mild cerebrospinal meningitis which surely would have been diagnosed as tuberculous without the proof supplied by the lumbar puncture. In tuberculous meningitis the Von Pirquet test is regularly positive. Exceptionally due to the failure of reactive power in the organism against the overwhelming infection, this test may be negative.

The most frequent error made is in the cases of grave systemic poisoning with active cerebral manifestations. In pneumonia, scarlet fever, heat prostration, and in the acute intestinal infections, the stupor, the convulsions, and vomiting often are interpreted as due to meningeal involvement. In toxic cases of such a nature the evidence supplied by the absence of the distended fontanel, the absence of eye symptoms, and the absence of the respiratory and pulse phenomena point strongly to a meningismus and not to a meningitis. It must be remembered

that any cardinal symptom of meningitis may be present in one of these acute toxic processes. In meningitis, however, we have a grouping of symptoms—a symptom-complex which renders a diagnosis practically positive.

Points of value in differentiating tuberculous meningitis, the cerebral type of poliomyelitis, and epidemic encephalitis are presented on pages 621 and 623.

**Prognosis.**—The prognosis is most unfavorable. We have seen a large number of cases, both in hospital and private work, and have never known a recovery of a positively proved case. Recoveries have been reported, however, by competent observers.

Archanzelsky, of Moscow, reported the recovery of a girl eight years of age who showed the characteristic symptoms of the disease, and in whose cerebrospinal fluid a large number of tubercle bacilli were found. This writer found in the literature instances of recovery in 50 cases of tuberculous meningitis, the existence of which he considered proved.

**Duration.**—The duration of the disease varies. Few cases pass the third week and many terminate fatally within one week from the onset.

An exceptional case was that of a girl three years old, who lived six weeks from the onset of the symptoms.

**Treatment.**—No treatment is of curative value. For the comfort of the family and the relief of symptoms the measures suggested under the treatment of simple meningitis (p. 605) may be followed out.

*Withdrawal of the cerebrospinal fluid*, removing the pressure within the cranium, may furnish temporary relief from the very active symptoms of convulsions, restlessness, and muscle contractions. The fluid returns, however, and the fontanel, which was sunken after the tapping, is soon bulging as much as before. The curative value of the lumbar puncture, according to our observation, is nil.

#### CEREBROSPINAL MENINGITIS (MENINGOCOCCUS MENINGITIS)

In 1866 Samuel Webber recorded over a score of epidemics occurring between the fourteenth and nineteenth centuries, which presented the features of this form of meningitis, giving rise to such designations as "typhus syncopalis," "petechial fever," "fièvre cérébrale," and "céphalologie épidémique."

Danielson and Mann described an epidemic which attacked Massachusetts in 1806, and in 1811 Elisha Hirth published a very full account of "a malignant epidemic called 'spotted fever.'" Since this period, according to Dr. A. Jacobi, outbreaks of the disease have been more extensive in America than in any other country. In the years 1904 and 1905 New York City underwent a very severe epidemic, which caused about 3400 deaths, and in the winter of 1904 attained a mortality of 91 per cent. At this time a commission appointed to investigate the disease reported the presence of the meningococcus, as shown by cultures from the nasal mucosa, in 50 per cent. of the patients and in 10 per cent. of their attendants. This organism, also known as the *Diplococcus intracellularis* of Weichselbaum, was discovered in 1887. Heubner first showed the existence of the same agent in the spinal fluid of a living patient.

**Etiology.**—Cerebrospinal meningitis occurs sporadically and in epidemic form.

The disease is one of childhood. It may occur in earliest infancy, however, or in extreme old age. From two to ten years appears to be the most susceptible age. Rotch had a patient six days old. Koplik's youngest patient was four months of age.

**Bacteriology.**—The organism is a Gram-negative diplococcus, and when found in the pus cells of the infected spinal fluid in a typical smear presents an appearance much like that of the gonococcus in a gonorrheal smear.

The meningococcus is very sensitive to light, cold, and drying, and its cultures die out rapidly, so that its transmission by the air seems improbable.

Meningococci are not all identical in their serologic reactions; but fall into two main groups which have been termed "normal" and "parameningococcus" strains. Many strains should be employed in making a polyvalent serum for therapeutic use, in order that immune bodies in both groups of meningococci may be produced. The parameningococci were first described by Dopter, who isolated them from the nasal secretion and later they were found in the spinal fluid of cases of cerebrospinal meningitis. There are no morphologic or biologic differences between the two types of meningococci.

**Mode of Invasion.**—The presence of the meningococcus in the bloodstream has been the subject of particular study by Herrick and other observers who have held that there was a general meningococcemia of a transient nature derived from a local focus in the nasopharynx, and that the infection of the meninges occurred subsequent to that of the bloodstream, particularly through the medium of the choroid plexus. Herrick was able to recognize the premeningitic stage in 45 per cent. of 265 cases and stated that positive blood-cultures could be obtained in 50 to 80 per cent. of the cases. By other observers who found the organism in the blood in a smaller proportion of cases it has been assumed that even when cultures from the blood are not obtained the blood nevertheless acts as the means of carrying the infection to the meninges.

Furthermore, the petechial eruption seen in connection with other septicemic manifestations in this disease has been found to contain meningococci.

If at times direct extension of infection through the cribriform plate of the ethmoid may initiate the meningeal infection, the fact seems indisputable that hemic infection constitutes the usual means of localization of the organism in the nervous system.

The organism has been found in the lungs and joints.

**Pathology.**—Notwithstanding the general nature of this disease, as shown by its fulminant course and the existence of such symptoms as petechiæ, purpura, and herpes, the lesions produced are quite closely limited to the central nervous system. Here the conditions found in cases of simple meningitis are roughly simulated. Enlargement of the spleen, multiple abscesses, acute nephritis, hepatic degeneration, and pneumonia may also be found.

The exudate covering the brain is usually lighter in color and thinner than in pneumococcus meningitis and in sporadic cases of the menin-

gococcus type. The cord and base of the brain only, or even the cord alone, may show the presence of the lesions. The affected portions of the brain are covered with the seropurulent or purulent fluid and patches of fibrinous exudate, and the cerebral convolutions are more or less flattened, depending on the degree of accompanying hydrocephalus. This last condition is most marked in the posterior basic inflammations, in which the foramina of the ventricles are occluded. In very malignant cases there may be no postmortem evidences but those of an acute toxemia. (Sporadic cases, correctly identified neurologically and anatomically, have been unnecessarily classified clinically under the term "posterior basic meningitis.")

The *cerebrospinal fluid* is turbid. Whether it is greatly increased in amount or not depends upon the severity of the infection. The turbidity is explained by the high content of pus cells within which may be found the meningococcus. A high cell content with abrupt variations may be noted for some time after improvement has begun following the administration of serum. In some instances meningococci have been found on postmortem examination in the lateral ventricles, although during life the cerebrospinal fluid obtained on lumbar puncture has been free from organisms. Such cases have been of the fulminating type.

**Symptoms.**—In common with all disease in which the infecting agent is microbic in character, cerebrospinal meningitis may exist in so mild a form that it is not suspected, or it may be sufficiently severe to take the life of the child in a few hours. This very severe form is usually found among the earlier cases in an epidemic.

*Illustrative Cases.*—During the epidemic of 1904 and 1905 in New York City 2 patients—one a child of nine months and one a child of four years of age—were presented before students at the New York Polyclinic Medical School and Hospital. In neither child could the men on the benches discover anything wrong.

In the younger child the only symptom was a rather full fontanel and a tendency to drowsiness when left alone. At that time his cerebrospinal fluid contained the meningococcus.

The four-year-old child had headache and some photophobia and was extremely irritable. There had been vomiting, and there was an irregularity in the heart action. This boy sat up, answered questions, and did not appear at all ill.

The day previous meningococcus had been found in the cerebrospinal fluid.

Both children recovered without treatment.

On the other hand, during the same epidemic a girl of eight years was taken ill with the disease in the early morning and died about 10 o'clock at night on the same day.

*Fulminating Cases.*—The symptoms of these cases are from the onset most severe. The child is literally "struck down." The earliest symptom may be a violent chill, followed by fever, or the initial symptom may be a convulsion. If at this period there is a convulsion, the child rarely comes completely out of it. Active vomiting may be present. Extreme irritability usually precedes the comatose state, which rapidly supervenes. Whatever may be the early manifestations in any fulminating case, two symptoms are usually present—intense headache and high fever. The heart action becomes very rapid, breathing is superficial and irregular, the pupils show no response to light, and the child cannot be roused. Rigidity of the neck muscles and general muscle contractions may be present. There is intense hyperesthesia, the slightest sound or touch being acutely felt and resisted, the child perhaps throw-

ing himself about during the first hours so that he is with difficulty kept in bed.

Petechiæ appear, and ecchymotic areas soon are scattered over the surface. This symptom, however, does not occur in all cases. Extensive hemorrhagic purpura is of occasional occurrence in cerebrospinal meningitis.

In 2 such cases large areas of the body surface were involved in subcutaneous hemorrhage. It is peculiar that in these cases the nervous manifestations were much less pronounced than in the average case. Diagnosis was proved by the typical findings in the cerebrospinal fluid.

Between the mild and fulminating types of the disease symptoms of any degree may exist, indicating the varying degrees of virulency of the infection.

As a rule, the onset is more abrupt than in other forms of meningitis.

*Headache* is a fairly constant symptom in all cases. This will be evidenced by complaint on the part of the child, or in younger children by head-rolling, head-boring, or striking the head with the hands.

*Vomiting*, severe, repeated, and projectile in character, without relation to the taking of food, frequently marks the onset, and may persist during the irritative stage.

*Position of Patient.*—The posture when the case is fully developed is characteristic. The patient rests on his side; the head is retracted, the knees are drawn up, and the legs are flexed on the thighs; the arms are flexed and the hands clinched.

*The Fontanel.*—Distention of the fontanel in the younger patients is a constant and very reliable sign.

*The Temperature.*—There is no characteristic temperature range in the disease. The temperature is variable and irregular—now high, now low.

*Convulsions* occur in a majority of the cases. There is always hyperesthesia, and evidence of much discomfort when the child is handled.

*Muscle rigidity* is usually present, even in the milder cases. The entire body may be involved and become stiff and rigid, or a single muscle group only may be involved. Rigidity of the neck and some degree of opisthotonos are rarely absent except in the milder cases. The feet are held in a position of extension. Swallowing is difficult or impossible, and toward the end, in fatal cases, gavage has to be employed. In the recovery cases, also, during the active stages of the disease, this measure may be necessary to sustain the patient.

*Heart and Respiration.*—The heart action is much disturbed. It may be very rapid or slow. The usual condition after the development of coma is that of slowness and irregularity.

The respiration likewise is slow and irregular, and may assume the Cheyne-Stokes type.

*The Blood.*—A leukocytosis ranging from 25,000 to 40,000 with a polynucleosis as high as 80 per cent. is the rule. Blood-cultures may be positive during the premeningitic stage.

*Mental Apathy.*—The child becomes extremely dull, and is aroused with difficulty. From this condition he may recover, or, what is more

frequently the case, he passes into a condition of complete stupor and coma.

*Abdominal Condition.*—The bowels are usually constipated and the abdomen is retracted. These symptoms, made much of by writers, are very variable and may or may not be present in severe cases.

The *eyes* frequently show strabismus. The pupils are usually dilated, often unequal in size, and show no response to light, or react but slowly.

*The Ears.*—Deafness may occur early and continue throughout. In the absence of local ear changes it is due to an inflammatory involvement of the auditory nerve.

*The Skin.*—In but a few cases personally seen by us have there been skin lesions. Petechiæ and ecchymoses have been seen in the very malignant forms. The skin in the mild and moderately severe cases has remained negative.

References to other manifestations typically attending the disease are included below under *Diagnosis*.

**Symptoms in Recovery.** *Cases.*—In a case in which there has been a moderately severe infection and which goes on to recovery, there is a train of symptoms indicative of the favorable outcome.

As might be expected, a general clearing of the dulled mentality is one of the earliest and most favorable signs. The temperature, which, though variable as to degree, is almost always present, subsides. The child manifests a desire for food, and makes attempts at using his stiffened muscles. Muscle rigidity is the last symptom to disappear. The writer has repeatedly known children to talk, to play, and be interested in their surroundings; in fact, apparently well, with the exception of the muscle contraction which held them in the characteristic position of opisthotonos.

*Illustrative Case.*—A boy seen at various times in consultation with a colleague was blind for six weeks, absolutely deaf for three months, and on his back for five months, yet made a perfect recovery. Toward the end he was emaciated to a skeleton. The child was seen on three occasions, and each time given a fatal prognosis. Four months after the last fatal prognosis he was seen on the street playing with other boys.

**Diagnosis.**—Abrupt onset is the rule. Convulsions, vomiting without apparent cause, chill, headache, more or less intense photophobia, hyperesthesia, rigidity of the neck muscles, and fever constitute the earliest diagnostic signs. Such a symptom-complex, followed by drowsiness and stupor, warrants the use of lumbar puncture (p. 821) to determine positively the presence of meningitis. This should be done in all suspected cases so as to give the patient the benefit of the serum at the earliest possible moment. The later manifestations of the disease are unmistakable. The rigid neck, opisthotonos, the dilated, unequal and immobile pupils, the slow, irregular respiration, and slow, irregular pulse, comprise a group of diagnostic signs found only in meningitis.

*Hyperesthesia* is always present. The child almost invariably cries when disturbed or handled in any way, so long as his mentality is still able to appreciate the disturbance.

*Kernig's Sign.*—This consists in an inability to extend the leg on

the thigh when the latter is flexed on the abdomen. The sign is present and is fairly reliable in children over two and one-half years of age. In younger children, particularly those under eighteen months, because of the normal tendency to contraction of the flexor muscles at this period of life, the sign is of less value.

Kernig's sign is also present with other cerebral lesions and in other forms of meningitis.

*Babinski's phenomenon* consists in an extension of the great toe and a flexion and separation of the remaining toes when the plantar surface of the foot is stroked with the finger. This sign is often absent, and is of corroborative value only in the event of other symptoms. Its presence may be an indication of meningitis, yet its absence is of no significance. This reflex may be elicited in normal children under eighteen months of age.

The *tache cérébrale* may be demonstrated in practically every case.

The *patellar reflex* is variable and uncertain. It may be increased, diminished, or absent, and is of little diagnostic value.

*The Eye Changes.*—The pupils are usually dilated, often unequal, and may show no response to light or react slowly.

Strabismus is always present at some stage. The eye-grounds may show retinitis, choroiditis, or neuritis of the optic disk. In the prolonged cases conjunctivitis and keratitis are often present.

The *pulse, respiration, and temperature* are all variable, but, studied together, may afford evidence of great value in confirming a diagnosis of meningeal irritation.

*Emaciation.*—There is such a marked loss in weight that the emaciation may be looked upon as one of the significant symptoms of the disease. In all cases there is wasting, and the longer the case, the greater is the emaciation.

A ward filled with these emaciated children, with their dulled, staring eyes and bent, rigid trunks and limbs, furnishes a most pitiful and gruesome picture.

**Differential Diagnosis.**—In spite of the foregoing signs and symptoms numerous cases of cerebrospinal meningitis may only be differentiated from other types by an examination of the spinal fluid, the characteristics of which in this disease have been described on page 612.

**Complications.**—Considering the nature and severity of its symptoms, cerebrospinal meningitis is a disease with few complications. Pneumonia is an unusual occurrence. Eye involvement is to be looked upon more as a feature of the disease than as a complication. Nephritis is exceedingly rare. Bed-sores are frequently developed, and become very troublesome, but again decubitus cannot properly be considered a complication.

Among the sequelæ are idiocy, blindness, deafness, epilepsy, acute and chronic hydrocephalus, and spastic paralysis of different sets of muscles.

Several of the writer's patients who survived meningitis and were considered to have had complete recoveries, were nevertheless backward in school, had severe headaches, or showed lack of mental control.

**Duration.**—The duration of the disease depends largely upon the

nature of the infection. Death may take place in a few hours, or the patient may linger for weeks.

A boy twelve years of age died from exhaustion in the twentieth week of the disease.

Children not infrequently make partial recoveries, linger for several weeks in a wretched, emaciated condition, and eventually die from asthenia. Others make incomplete recoveries which place them in the dependent class for the remainder of their lives.

**General Treatment.**—The medication and general management in cerebrospinal meningitis are the same as suggested for acute infective meningitis (p. 605). Little or nothing is to be expected from drugs, except such as may be used for palliative purposes.

**Serum Treatment.**—The Flexner serum is the only agent which promises any curative effects in the disease. In 1904 Flexner produced an antimeningitic serum for the treatment of cerebrospinal meningitis. Horses were immunized by graded injections of cultures of the *Diplococcus intracellularis* and its toxin. He distributed this serum to many observers throughout the world, and in 1913 made a final report of 1294 cases which had been treated with this serum, which is injected intraspinally. The effect of the serum is partly bactericidal, partly by bringing about phagocytosis, and probably partly by an antitoxic reaction. Previous to the use of the serum the mortality ranged from 50 to 90 per cent.; since its use the mortality has been reduced to from 20 to 30 per cent. The following are statistics of results as compiled by Flexner<sup>1</sup>:

#### MORTALITY ACCORDING TO AGE

Age.	Cases.	Recoveries.	Deaths.	Mortality.
Under 1 year. ....	129	65	64	49.6
Between 1 and 2 years. ....	87	60	27	31.0
Between 2 and 5 years. ....	194	139	55	28.4
Between 5 and 10 years. ....	218	185	33	15.1
Between 10 and 20 years. ....	360	254	106	29.4
Over 20 years. ....	288	180	108	37.5
Age not given. ....	18	11	7	38.9
Total. ....	1294	894	400	30.9

#### MORTALITY ACCORDING TO PERIOD OF FIRST INJECTION

Period of injection.	Cases.	Recoveries.	Deaths.	Mortality.
First to third day. ....	199	163	36	18.1
Fourth to seventh day. ....	346	252	94	27.2
Later than seventh day. ....	666	423	243	36.5
Total. ....	1211	838	373	30.8

The average mortality rate of the patients of 19 observers who published their results in the literature was 29 per cent. This compilation totals 4664 cases, with 1338 deaths.

<sup>1</sup> Jour. Exp. Med., May, 1913.

The use of serum gives the best results when injected early and in children between the ages of five and ten years. The serum is useful, however, even if injected late in the disease. Infants under one year do not respond readily to the serum. With the use of the serum 30 per cent. of the favorable cases terminate abruptly, while without serum crises are unusual. When the first injection is made within the first three days, 50 per cent. terminate by crisis. There has also been a remarkable reduction in the severity and number of complications by the use of serum. Out of 894 children in Flexner's series who recovered, 68, or  $7\frac{1}{2}$  per cent., had complications as follows:

39 cases	Total deafness	4.4 per cent.
6 "	Partial deafness	0.7 "
3 "	Total blindness	0.3 "
6 "	Partial blindness	0.7 "
3 "	Impaired mentality	0.3 "
11 "	Paralysis	1 "

There have been some noteworthy improvements in the serum since it was first introduced. Many children were found who did not react favorably. Investigations proved that there are various strains of the meningococcus; notable among these is the parameningococcus. Horses used to supply the serum are now injected with the cultures of these different strains.

Because of the prevalence of the disease among the soldiers at the front on the continent it was found necessary to hasten the production. Wollstein and Amoss<sup>1</sup> accordingly perfected a method by which the serum could be produced in eight to twelve weeks instead of six to twelve months as previously.

*Method of Use.*—The first injection of serum is given in a suspected case as soon as turbid fluid is withdrawn, without waiting for bacteriologic examination. It is best to withdraw all the fluid possible at each puncture and then inject 25 to 35 c.c. of serum by the gravity method. Four injections given daily is the average, but some patients require as many as twelve. In the very severe cases the second injection should follow in twelve hours. Even though an injection does not seem necessary, a puncture should be done every day or two during the course of the disease for bacteriologic examination. The most important indication for an injection is the clinical aspect of the patient. Even though the fluid becomes clear and no diplococci are found, if there is persistent Kernig's sign, irregularity of temperature or mental disturbance, a repetition of the injections is necessary.

Soon after one or two injections of the serum in favorable cases the diplococci in smears are greatly reduced in number and finally disappear. The organisms should also present changes in appearance, as swelling and fragmentation, stain diffusely and indistinctly, and lose their mobility in cultures. The purulent spinal fluid becomes more translucent and finally clears. A reduction of the leukocytes in the blood follows if the serum is successfully combating the disease.

*Technic of Spinal Injection.*—The child is placed in the recumbent

<sup>1</sup> Jour. Exp. Med., May, 1916.

position recommended for spinal puncture. If the patient is an infant and can be properly held by an assistant, no anesthetic is necessary. Chloroform had best be administered to the older children who resist holding. The gravity method is preferable to the syringe. Sophian, of New York, has perfected a blood pressure control for the withdrawal of fluid and the injection of serum. When the spinal fluid is being withdrawn there should be a drop of not more than 5 to 10 mm. of mercury. In case of a further drop no more fluid is removed. The funnel of the apparatus is filled with serum which has been heated to body temperature. All air should be carefully eliminated from the connecting tube. The funnel is gradually raised to permit the serum to flow in gradually by gravity. It is seldom possible to inject as much serum as fluid withdrawn without disconcerting symptoms. If the blood-pressure drops 10 mm. of mercury the process should be temporarily discontinued until the normal blood-pressure is restored, at least in part. When the pressure continues to fall, the injection should be discontinued. It is always a wise precaution to keep the tube connected for three minutes after the injection, so that the serum may be withdrawn by lowering the tube if the child shows a falling pressure, dilatation of the pupils, or shallow irregular respirations. If these symptoms supervene, the head should be raised and injections of atropin and adrenalin administered intramuscularly.

The spinal fluid in some cases will become clear and show very few meningococci and yet the fever and prostration continue. This may be due to adhesions or thick exudate at the base of the brain which does not allow the serum to reach the meninges or the lateral ventricles. When this occurs it is necessary to puncture the ventricle through the anterior fontanel, withdraw the fluid and inject the serum. In older children trephining may be necessary. Another not unusual obstacle to the treatment with serum is a very thick gelatinous fluid which is withdrawn with difficulty. In such cases Sophian has recommended careful irrigation with normal saline to aid the withdrawal of the fluid.

*Serum Administration Through the Blood-stream.*—Following the demonstration of meningococcus septicemia as a most highly important feature of the disease the rationale of administering serum not only intraspinally but intravenously and intramuscularly has been generally appreciated. Particularly because of the difficulty often encountered in administering a sufficiently large dose by the spinal route is it advisable as a routine procedure to give full doses of the serum intravenously and intramuscularly, thus attacking the infection generally as well as at its region of localization. The value of the intravenous administration is undoubtedly greatest at the onset of the disease.

Severe *anaphylactic reactions* following the administration of anti-meningococcus serum at times occur. The experience of Blackfan<sup>1</sup> has led him to advise that the patient be first desensitized by a subcutaneous injection of 1 c.c. of the serum. One hour later the intravenous dose may be given. This may range in amount from 15 to 30 c.c. and should be injected slowly at first at the rate of about 1 c.c. per minute. In the event of shock the injection is to be immediately discontinued and the untoward symptoms combated by epinephrin and atropin given hypo-

<sup>1</sup> Biologic Therapy, 1921, Amer. Med. Assoc., pp. 16-24.

dermically. True anaphylaxis may require desensitization of the patient to horse-serum if the antimeningitic treatment must be continued.

*Duration of Serum Treatment.*—The intraspinal injections must be continued at frequent intervals in some instances for a considerable number of days. When the clinical picture presented by the patient is one of established improvement, indicated both by lessened temperature and falling leukocytosis, and when the organisms in the spinal fluid are greatly diminished in number or have disappeared the injections may be omitted even though the spinal fluid may still show turbidity from the presence of leukocytes, a condition that may in some instances be kept up by the occurrence of a considerable degree of local reaction to the serum. If after a few days without specific treatment the signs again become unfavorable further intraspinal injections may again be justifiable.

*Vaccine.*—The first cultures obtained are sometimes used for the preparation of an autogenous vaccine. This may be employed if the case takes a chronic course.

### MENINGISMUS (SEROUS MENINGITIS)

“Meningismus” is a term first employed by Dupré to describe cerebral intoxication, a condition clinically closely resembling meningitis, in which the spinal fluid is sterile. This condition may occur in typhoid, acidosis, acute gastro-enteric intoxication, influenza, pneumonia, or any of the exanthemata. Very severe scarlet fever is apt to be accompanied by meningismus.

*Symptoms.*—There may be stupor, coma or convulsions, retraction of the head, vomiting, and twitchings of the face or various parts of the body. In fact, the symptoms so closely resemble true meningitis and acute polio-encephalitis that a differentiation is only possible in some instances by means of lumbar puncture.

*Diagnosis and Differential Diagnosis.*—In true meningitis, whether simple, acute cerebrospinal, or tubercular, micro-organisms are present in the cerebrospinal fluid, the cell count is increased, and globulin is usually present. The pupils may be dilated or contracted and show slow response to light, but in meningismus they act together and evenly. We have never seen the symptom of absence of co-ordination of the pupils in simple meningismus. The eye-ground changes in meningismus are, moreover, negligible.

Finally, it is to be remembered that with meningismus there is usually the association of other diseases, and the cerebral signs are secondary.

*Lumbar Puncture.*—In any case showing active cerebral symptoms, a lumbar puncture should always be made. (See p. 821.)

*Treatment.*—The treatment is covered in the management of the disease with which the meningismus is associated.

### EPIDEMIC ENCEPHALITIS (ENCEPHALITIS LETHARGICA; NONA)

*Definition.*—Epidemic encephalitis is an acute infectious epidemic disease of the nervous system characterized by fever, lethargy, and various abnormal motor phenomena.

*History.*—The disease has been noted by several writers following

epidemics of grip during the past two hundred years. Encephalitis was recognized after the wide-spread epidemic of 1890, and since the pandemic of influenza in 1917-18 and 1920 has been the subject of much concentrated study.

**Etiology.**—The tendency for this disease to appear following influenza epidemics has been uniformly noted. Several organisms have been isolated, mainly from the nasopharyngeal secretions, but no one has been widely accepted as the causative agent. That the disease is caused by a globoid filtrable organism similar to that assigned as the cause of poliomyelitis and may be transmitted similarly from individual to individual is probably true, but little is known of its communicability. Encephalitis occurs without regard to age, but is rare under four years. Males are apparently slightly more prone to the infection. The first three months of the year show the highest incidence.

**Pathology.**—The lesions occur regularly in the brain and consist of edema, congestion, and minute hemorrhages in the gray matter about the base, the third ventricle, the aqueduct of Sylvius, the lateral ventricles, the optic thalamus, and the pons and medulla. The cord may be involved. The lesions may be nodular or diffuse and consist of intense perivascular infiltration with lymphocytes, plasma cells, and a few polynuclear cells. There is pathologic proliferation; and degeneration of nerve-cells, fibers, and vessel walls may occur. There is little meningeal reaction. The paralyses which occur usually are due to invasion of motor nuclei by cellular elements.

**Symptoms.**—The onset is usually abrupt, with fever, malaise, headache, vomiting, constipation, and prostration. The variety of symptoms referable to the central nervous system is endless. Drowsiness, especially during the day, with insomnia at night, is common. In infants convulsions may usher in the disease. Delirium may be an accompaniment. Ocular symptoms are very common. Diplopia, strabismus, ptosis either unilateral or bilateral, blurred vision, blindness, nystagmus, and irregular convulsive or rotary movements of the eyes are frequently seen. A viscid conjunctival exudate without redness has occasionally been noted. Choked disks have been reported.

Paralyses, especially of the cranial nerves, may be transient or persist over a long period. Myoclonic manifestations run the gamut from fibrillary twitchings to coarse tremors. The reflexes are variable and irregular throughout, but the typical signs of meningitis, such as stiff neck and Kernig's sign, are uncommon. The face in a typical lethargic case is expressionless and mask-like. Some patients refuse to talk, others may be so persuaded, and their speech is slow, measured, and monotonous. The fever is of low grade, entirely irregular in its curve, falling to normal even for days, and then rising to 101° to 102° F. without apparent reason. It is typical of epidemic encephalitis that the patient shows periods of marked improvement, with subsidence of symptoms, only to relapse later with new manifestations.

The duration of the disease varies from two weeks to several months, averaging in children, according to Neal, about six weeks.

**Laboratory Findings.**—The *leukocyte count* may be normal or slightly increased. The *spinal fluid* is clear, or occasionally slightly blood-tinged,

and is very slightly increased in amount. No film forms on standing. The cell count is normal or increased up to 150 cells, all lymphocytes. Albumin and globulin are slightly increased. Sugar is present and is, as a rule, increased in amount. This may only be detected by the finer methods of quantitative analysis. The Wassermann and colloidal gold reactions are negative. The *urine* is ordinarily negative.

**Sequelæ.**—Probably the most common sequelæ of epidemic encephalitis in children are psychiatric. There is complete change in personality and disposition, with oddities of behavior, unstable emotions, incorrigibility, sexual precocity, depressions, hysteria, fears, and retarded mental development. These phenomena are much more common than the parkinsonian syndromata seen as sequelæ of this disease in adults. However, true neurologic sequelæ do occur frequently in the form of choreiform movements, headaches, dizziness, drowsiness, diplopia and other visual disturbances, muscular weaknesses, and even endocrine changes.

**Diagnosis.**—Epidemic encephalitis is diagnosed mainly by elimination, especially from tuberculous meningitis and encephalitic poliomyelitis. This differentiation is often a problem of the utmost difficulty.

The mode of onset in encephalitis is usually more abrupt than in tuberculous meningitis, its course is usually longer, and its neurologic manifestations are more bizarre. The spinal puncture is a valuable aid in diagnosis, as the tuberculous fluid early shows a diminished or absent sugar reaction, forms a film, and the organisms can be demonstrated.

Encephalitic poliomyelitis has a more abrupt onset and runs a stormier and shorter course. The spinal fluid sugar content in poliomyelitis is little, if at all, increased.

Brain tumor and brain abscess are to be considered.

The Wassermann and colloidal gold tests will almost surely detect syphilis of the central nervous system.

Encephalitis is only occasionally confused with other conditions than those mentioned, but exceptionally may be wrongly diagnosed in the presence of typhoid fever, postdiphtheric paralysis, uremia, hysteria, or even botulism.

**Prognosis.**—During the acute phase the prognosis is uncertain, as death may occur at any stage. Intercurrent infections are to be dreaded. In general, the mortality figures are about 28 per cent. The prognosis as to sequelæ should be most guarded as improvement is slow and uncertain.

**Treatment.**—The treatment is entirely supportive and symptomatic. Hyoscin, gelsemium, and belladonna have been reported to be of value in the treatment of sequelæ of the parkinsonian type. Serum treatment has been employed by a number of investigators without convincing success.

Transfusion has apparently been followed by striking improvement in a few instances.<sup>1</sup>

<sup>1</sup> The rapid change in a recent early typical lethargic case thus treated by Stetson in the Children's Medical Division at Bellevue Hospital was sufficiently convincing and unprecedented in the experience of independent observers to suggest a more general trial of transfusion in this baffling disease.

## DIAGNOSTIC CHARACTERISTICS OF CEREBROSPINAL FLUID

In the differentiation of the various forms of meningitis, poliomyelitis and encephalitis, and various other intracranial disease conditions the examination of the cerebrospinal fluid is absolutely essential. The characteristics noted in the respective conditions are approximately as given in the table on page 623.

Fluid.	Pressure.	Appearance.	Cell count.	Predominant cell.	Bacteria.	Albumin.	Globulin.	Benedict's solution reduced.	Quantity of sugar.	Quantity of protein.
Normal.....	Normal.	Clear.	1 to 10	Mononuclear.	0	±	±	+	50 to 60	30 to 60
Meningismus ..	Normal or increased.	Clear.	5 to 10 or increased 10 to 60	Mononuclear.	0	±	±	+	50 to 60	30 to 60
Hemorrhage.....	Normal or increased.	Red or yellow.	Normal.	Mononuclear.	0	++	++	+	50 to 70	50 to 100
Polionyelitis .....	Normal or slightly increased.	Clear.	10 to 90	Mononuclear.	0	± to +	± to +	+ to ++	40 to 80	50 to 120
Encephalitis. . .	Normal or increased.	Clear.	10 to 100	Mononuclear.	0	± to ++	± to ++	+++	70 to 120	70 to 250
Tuberculous meningitis	Normal to greatly increased.	Clear or slightly cloudy.	40 to 400	Mononuclear.	Tubercle bacilli.	+ to ++	+ to ++	0 to +	0 to 20-30	100 to 800
Purulent meningitis.....	Normal or increased.	Cloudy.	To 1000	Polynuclear.	Present.	++ to +++	++ to +++	0	0 to 10	300 to 2000
Brain tumor.....	Normal or increased.	Clear.	5 to 10	Mononuclear.	0	±	±	+ to ++	50-90	50

## XVII. DISEASES OF THE SKIN

THE skin of an infant is to be looked upon as an organ with important functions to perform. On account of its location it is the most exposed organ of the body, while among its most important functions is protection of the underlying structures.

In the skin, moreover, are located the most important organs of excretion, the sweat glands, as well as those very delicate nerve structures, the tactile organs. Through the skin heat radiation is carried on by means of the circulating blood in the capillaries. When we consider the active metabolic processes that are taking place in the infant's body, it is not hard to appreciate the amount of work the skin is called upon to do in performing its functions of excretion and heat radiation.

**Care of Skin in Health.**—The skin in early life is particularly delicate, and responds very readily to external irritation of any nature. Excessive clothing at any time of the year, but more particularly in summer, produces the well-known prickly heat, or miliaria. Dermatitis may result from the irritant effects of improper clothing.

The different forms of intertrigo are the result of irritation produced by the contact of unclean napkins containing urine or feces, or both. In order to avoid intertrigo the napkin must be changed during the waking hours whenever the urine is voided. In some instances it is not well to wake a child for a change of napkin because of urination; and at other times during the day, such as the outing period, the clothing cannot always be changed in the park or street. Under such circumstances a prophylactic measure should be employed. Over the groin and folds of the buttocks should be spread pieces of old linen which have been well smeared with the following ointment:

R. Cerae albæ..... ℥iv  
 Ungt. zinci oxidi..... q. s. ad. ℥iv

The addition of white wax to zinc oxid ointment affords a waterproof dressing to the skin, and protects it from the irritating products of decomposing urine. (See also The Ammoniacal Diaper, p. 102.)

Clothing that is applied too tightly will often act as an irritant to the skin. To many wool acts as a decided irritant, and frequently it must be avoided. In some instances it is necessary to line the child's undergarments with thin old linen, such as a handkerchief. Linen mesh underclothing may be used.

In order further to keep the skin healthy, the child should be bathed in a tub once a day with Castile soap, then carefully dried, and powdered with a simple powder.

The following powder is of value:

R. Acidi borici..... gr. xxv  
 Pulv. amyli,  
 Pulv. zinci oxidi..... āā ℥ss  
 M. Sig.—Apply freely.

We prefer the evening bath. In the morning the child should be sponged with warm water and soap and carefully dried, after which the powder may be applied. During the cold weather the bathing and sponging should be done in a warm room with a temperature over 75° F.

The above simple means are all that are necessary to keep the skin in a normal condition. The skin of some children is, of course, much more sensitive than that of others, and will require more careful attention.

### MILIARIA (PRICKLY HEAT)

The rash in prickly heat consists of multiple, minute, transparent vesicles, due to an engorgement of the vessels of the sweat-glands and obstruction of their outlets. There is a definite inflammatory reaction distinguishing this condition from sudamina.

**Symptoms.**—The child is very uncomfortable and restless, due to the itching which is very distressing. The rash described is characteristic, and usually appears quite suddenly. The mild cases are without inflammation. The inflammation, when present, produces a general erythema with many reddened papules.

**Etiology.**—Nearly every infant in our climate suffers from prickly heat during the summer. The condition in summer is caused by profuse sweating incident to the hot weather and independent of possible overclothing; in winter too hot living rooms and overclothing may cause the condition.

**Treatment.**—Heavy clothing and flannels are to be avoided. In order to lessen the local irritation the garment worn next to the skin, unless of linen mesh or cotton, should be lined with silk or linen. The further management directed both to the relief of the patient and the cure of the condition consists in the frequent application of cool water either by means of a tub-bath or sponging. The soda bath, the bran bath, and the starch bath (pp. 843, 844) are all useful. For purposes of sponging a solution of bicarbonate of soda should be used containing 1 tablespoonful to a gallon of water. The relief afforded the patient depends not so much upon what is used in the water, as upon the fact that plenty of cool water comes in contact with the itching, burning skin. Ointments and salves are of little service, as they tend to produce further maceration of the skin. As local applications powders are to be preferred to lotions. A powder used with satisfaction for this condition is of the following composition:

R.	Acidi salicylici.....	gr. v
	Acidi borici.....	gr. lx
	Pulv. amyli,	
	Pulv. zinci oxidi.....	āā ʒj

This is to be dusted freely over the involved surface several times daily—every hour if necessary. In case irritation is produced by the salicylic acid, it may be omitted or its strength may be decreased by the addition of powdered starch.

### URTICARIA (HIVES; NETTLE-RASH)

A discussion of all the aspects of urticaria is unnecessary. Only those forms will be considered which are peculiar to children.

Acute urticaria is characterized by the sudden appearance and disappearance upon the skin surface of wheals and lumps of vasomotor origin. The wheals, which are of varying size, produce intense itching and burning, and then subside without desquamation as rapidly as they have appeared. The variation in size and shape has given rise to a differentiation into types for purposes of diagnosis.

**Distribution.**—The possibilities of skin involvement in hives are most variable. There may be but one wheal, or the lesions may cover a large portion of the skin surface. The involved area may be very small, of the size of a pin head, or extremely large (Cf. Giant Hives, below), occasionally producing marked facial deformity.

Thus in the case of a child of eleven months who had been given an egg for the first time the face was so distorted and grotesque that recognition was impossible.

**Etiology.**—Urticaria may be due to agencies operating either from without or within the body. Those operating from without include irritants of almost any nature, especially the bites of insects, and too tight clothing or clothing which may directly irritate the skin. Contact with certain plants may also produce the wheal hives, termed "nettle-rash." Such causes as these, however, are operative in comparatively few cases.

Irritation arising from internal sources is the cause of the condition in at least 95 per cent. of the cases. The use of certain drugs may occasion sufficient irritation to cause an outbreak. In not a few instances hives have been due to quinin, arsenic, and antipyrin. The administration of antitoxin produces hives in a small percentage of the cases. Certain articles of food, such as strawberries, tomatoes, oatmeal, and buckwheat, invariably cause urticaria in certain children. An attack may occur without apparent digestive disturbance, or may appear coincident with vomiting, diarrhea, fever, and other acute gastro-intestinal symptoms. The condition represents an anaphylactic reaction with vasomotor disturbances of the skin blood-supply, resulting in localized vascular paralysis and transudation. The itching may be due to irritation of the nerve end-organs.

#### GIANT HIVES (ANGIONEUROTIC EDEMA)

This condition is of comparatively rare occurrence in children. It is simply a variety of urticaria occasioned by causes similar to those operative in other forms. When it occurs in children, it most frequently involves the tongue and lip. When involving the soft parts, the lesion may produce an immense amount of swelling. This is particularly marked when the tongue and lips are affected. The lips may be swollen to several times their normal thickness. Such cases usually develop suddenly and occasion no little alarm.

*Illustrative Case.*—In a boy four years of age the tongue and lower lip were so greatly swollen that speaking was impossible and swallowing difficult, and it was supposed that he had been given carbolic acid or some corrosive poison. This case necessitated a trip of 30 miles into the country to see the child in consultation.

Cases have been reported in which the swelling of the tongue was sufficient to produce suffocation requiring incision to reduce the swelling.

Practically all such cases in our experience have been associated with gastro-intestinal disturbances. The swellings ordinarily disappear rapidly after a few hours, but not with the rapidity that marks their initial appearance.

**Treatment.**—Digestive disturbances of any nature, whether acute or chronic, may cause urticaria. In the event of an attack, therefore, even though there be no active manifestations of indigestion, since the origin of the trouble may be found in the intestine, a safe procedure is to give 2 to 4 teaspoonfuls of castor oil, or  $1\frac{1}{2}$  grains of calomel in divided doses, followed the next morning by the citrate or milk of magnesia. At the same time the diet, regardless of the age, should be reduced to broths and gruels, to which toast or dried bread may be added, depending on the patient's custom. Milk should not be given. The application of a menthol ointment (menthol, 10 grains; rose-water ointment, 1 ounce) is a valuable supplementary measure.

In cases caused by antitoxin and food allergy, adrenalin in 3- to 5-minim doses given hypodermically will effect a termination of the symptoms sooner than will any other agent. Unfortunately the relief thus afforded is often only temporary and the urticaria again manifests itself after an interval of a few hours. Sodium salicylate has proved of special value in this condition. To a child three years of age 2 grains of the salicylate of soda may be given every two hours, with 4 grains of the bicarbonate of soda—five doses being given in twenty-four hours. To older patients from 3 to 4 grains of the salicylate may be given at a dose—from 12 to 24 grains being administered in twenty-four hours.

Certain children appear to be predisposed to urticaria, and give a history of having had several attacks. Unless treated for persistent intestinal indigestion they are very liable to recurrent attacks, which are sometimes very obstinate in character. Urticaria due to the ingestion of a drug will disappear when the drug is withdrawn.

The management of the cases due to local causes demands the removal of the source of the irritation and the application of the menthol ointment, or bathing of the affected part with a 1 per cent. carbolic acid solution.

#### RHUS POISONING (IVY POISONING)

Contact with *Rhus toxicodendron* produces in many individuals most active dermatitis, characterized by marked burning and considerable itching of the involved surface. There may be a simple erythema, but usually there are small vesicles and bullæ filled with serum, which, if they become infected, form pustules, with the possibility of multiple abscesses. The exposed portions of the body—the hands, arms, face, and neck—are the most frequently affected sites. When the face is involved great disfigurement may result.

**Treatment.**—In the acute stage—the period of itching, burning, and edema—a remedy of considerable value is a wet dressing of the fluid-extract of *Grindelia robusta*, 1 to  $1\frac{1}{2}$  drams to 1 pint of water, applied on lint or soft old linen. The solution should be used cold and renewed every fifteen to thirty minutes. During the stage of resolution a saturated solution of boric acid may be used in the same way, or, more con-

veniently, an ointment composed of 5 per cent. boric acid in rose-water ointment. This is applied to the parts on linen, after which resolution usually promptly takes place. When pustules develop, they must be opened and the parts treated with a wet dressing of a saturated solution of boric acid.

A solution of permanganate of potash, 1 : 2000, is a most satisfactory means of treatment. The involved parts are freely moistened with the solution at intervals of about two hours, the solution meantime being allowed to dry on the parts. This often readily controls the acute symptoms. After a few days a 10 per cent. boric-acid ointment may be used to soften the skin and remove the crusts and products of the exudation.

Another simple and readily obtainable topical application of undoubted value is a solution of plain photographic hyposulphite of soda crystals in the strength of 1 to 2 tablespoonfuls to a pint of cool water.

### SCABIES (ITCH)

Scabies is a contagious disease of the skin, caused by the burrowing of the female itch-mite, *Acarus scabiei*.

**Location.**—The parts selected for invasion are those portions of the skin which are least protected and least resistant, the favored sites being between the fingers and toes, the axilla, the groin, and the area immediately surrounding the umbilicus. The skin over the trunk is usually invaded secondarily.

**Lesion.**—The impregnated female burrows a tunnel into the layers of the skin, which serves as a habitat for the mite during her life.

In the burrow or canal are deposited the eggs, larvæ, and excretions of the acarus, and these act as an irritant, producing papules, vesicles, and skin infiltration. The presence of the parasite and its products causes intense itching which, through scratching, indirectly adds to the existing skin irritation. If the skin is clean, the burrows may be seen with the aid of a magnifying glass. Upon removal of the epidermis at the end of the canal the parasite may be removed with a needle.

**Diagnosis.**—Itching is intense and may be confined to the skin areas described, or involve all portions of the skin surface. A point of diagnostic value is that the itching is much worse at night due to the fact that the mite evidently becomes more active as a result of the increased warmth and quiet supplied by the unwilling host.

In a well-marked case as a result of the action of the acarus together with the trauma produced by scratching there is a complex skin picture very difficult to describe. An eczema with all its possibilities of skin inflammation and infection usually supervenes. The burrows have the appearance of dark colored lines extending in a tortuous, zigzag course rarely exceeding  $\frac{1}{2}$  inch in length, and these are usually visible in sufficient number to make the diagnosis positive.

**Treatment.**—The cases differ in severity, but in all the treatment is practically the same, varying only in respect to the necessity of its repetition or continuation. At bedtime a hot bath is ordered, from 105° to 110° F. While in the bath the patient is vigorously scrubbed with a towel and yellow laundry soap. After the scrubbing he is dried vig-

orously, and sulphur ointment, U. S. P., rubbed as vigorously into the skin. This process is repeated twice at intervals of forty-eight hours. The repetition at twenty-four-hour intervals is usually too irritating to the skin. The third treatment usually terminates the case. For quite young children, to whom the sulphur ointment may be too irritating, and for older children also, if the first application produces considerable dermatitis, the ointment may be diluted one-fourth or one-half by the addition of vaselin. Care must be exercised to destroy, boil, or otherwise disinfect all clothing previously worn by the patient.

### FURUNCULOSIS (BOILS)

Boils are frequent in delicate, poorly nourished infants and children, and are due to an inoculation of the deep layers of the skin with the staphylococcus. Boils may develop in well babies, even under proper management, for many delicate skins possess a very poor resistance. Often there will be a crop or two comprising perhaps not over five or six lesions in all. In marantic infants and poorly nourished young children, however, the lesions may occur in great number.

Over one hundred furuncles were opened in one patient in caring for the successive crops as they appeared.

The scalp is apparently the most fertile field for their development. Repeatedly the boils coalesce, forming a large, sloughing suppurating mass. In aggravated cases, in delicate infants with low resistance, fatal results are not unusual in institutional work. What might be looked upon as a chronic condition of furunculosis sometimes exists in older children. The boils will continue to appear at indefinite intervals for a year or more in spite of active vaccine treatment.

**Treatment.**—*Local.*—When pus is evident in the boil, a free incision should be made and the pus expressed. The skin about the wound should be washed vigorously with tincture of green soap or ordinary soap and water. Applying a few drops of a solution of bichlorid of mercury is of little or no value, and will not be sufficient to prevent a reinfection, as some pus invariably escapes upon the surrounding healthy skin when many boils are opened. A wet disinfectant dressing or a disinfectant ointment should follow incision and cleansing. Bichlorid dressings are to be used only temporarily for children. The dressing which has appeared best to prevent the spread of the infection when the involved area is not too large is a saturated solution of boric acid, applied by means of gauze or lint. In a marantic child, when a considerable portion of the surface over the trunk or thorax needs to be covered, the repeated renewal of the solution causes a reduction in temperature which is not desirable. In treating such infants, and in out-patient work where a wet dressing cannot be used, an ointment of 15 per cent. boric acid in vaselin may be thickly spread on lint and applied to the wound and a considerable portion of the surrounding area. The dressing should be changed every six hours. Ichthyol is of little service when used in a strength of less than 20 per cent. The odor is disagreeable; the application stains the skin and the clothing and controls the condition no better than does the boric acid ointment. Moreover, the latter is comparatively inexpensive.

Topical applications of solution containing 6 parts of picric acid and 60 parts of alcohol to 1000 parts of water have been found of value. Caution is essential in applying this to large surfaces.

In treating fat children who sometimes develop boils on the abraded surfaces at the folds of the neck or the nates, and children who perspire freely, a dusting-powder has been employed composed as follows:

R. Pulv. acidi borici . . . . . 3j  
     Pulv. amyli,  
     Pulv. zinci oxidi . . . . . āā ʒiiss  
 M. Sig.—Dusting-powder.

This is applied as soon as the wound is closed, and the parts are thus kept dry.

A method of great value in treating furunculosis in young patients consists in subjecting the affected surfaces to dry heat supplied by bright sun or an appropriately devised electric-light bath.

*Constitutional.*—The constitutional treatment is important. If the child is marantic or suffers from malnutrition, the general treatment suggested for these conditions should be brought into use. If delicate or anemic, the patient should have the advantage of extra care (pp. 140-146). In the many cases treated internal medication, other than that directed toward the improvement of the general constitutional condition, has been without value. The sulphid of calcium and other drugs which are supposed to have a direct influence upon the condition have proved of no service. Observation on a series of cases of this type, for which opportunity was afforded by institution work, has shown that those treated with the sulphid of calcium, for example, made no greater progress than did those to whom it was not given. (The existence of this line of treatment is an example of "heredity in medicine." A remedy advocated by some one of consequence in the past is handed down from generation to generation by writers, many of whom, not having had opportunity to support their advocacy of the measure with observations of value, simply repeat what has been said by their predecessors).

*Autogenous vaccines*, and in numerous instances, even stock staphylococcus vaccines have been most serviceable in treating furunculosis in infants and young children (p. 862).

*Bathing.*—No matter how extensive the process, children with furunculosis may be bathed as in health. To the water for the bath, which should first be boiled, bicarbonate of soda, 1 tablespoonful to the gallon, should be added. There should be little or no friction of the skin.

#### PEDICULI (HEAD LICE)

Head lice, (pediculi capitis), constitute a very frequent source of annoyance in out-patient and hospital work among children. Occasionally children better situated may become infected in school or in public conveyances and carry the vermin to other members of the family. Repeatedly all the female members of a household have been found infected.

*Symptoms.*—As a result of the irritation produced by the insect and the enforced scratching, an eczema of the scalp is of frequent occurrence. The eczema may be slight or give rise to a most extensive

and disgusting condition. The suppurating scalp, matted with pus, crusts, nits, and vermin, supplies a picture disagreeable even to consider. In not a few instances the brows and eyelashes are involved. A slight degree of postcervical adenitis is the rule in cases of some weeks' duration.

**Diagnosis.**—The diagnosis does not depend upon finding the live vermin. The louse cements its eggs to the hair, and the presence of the “nit” is in itself diagnostic.

**Treatment.**—The most successful and cleanly treatment consists in cutting the hair short. The head should then be washed with soap and water twice a day; and once daily after the drying the scalp should be thoroughly moistened with the following solution:

R. Acidi acetici .....	3ij
Ætheris sulphurici .....	3iij
Tincturæ delphinii,	
Spiriti vini rectificati .....	āā 3iv

Improvement will follow a few treatments. The pediculi will be killed and the nits may be removed with a fine-tooth comb. If the patient is a girl, it is not absolutely necessary to sacrifice the hair. It may be parted at various sites on the scalp and the solution applied, without the previous washing. However, if the hair is not cut, a much longer time will be required to effect a cure.

### TINEA CIRCINATA (RINGWORM)

*Tinea circinata*, ringworm of the body, is a highly contagious parasitic skin infection.

**Etiology.**—The disease is due to the *trichophyton* fungus, which is identical with that causing *tinea tonsurans*. The exposed skin surface, the neck, and hands are the sites most frequently involved.

Domestic animals are subject to the disease. It is rare in cows and horses, but quite common in dogs and cats. Children are often infected from cats and dogs.

**Symptoms.**—The disease usually makes its appearance in the form of a small, reddened, irregular-shaped area, which soon becomes circular and is covered with a fine, scaly desquamation. The area is sharply defined and spreads through the development of fine papules around the border of the patch. As the process extends there is a paling and smoothing out of the surface in the middle of the patches, while the exterior border remains somewhat elevated and reddened. This produces in the lesion a ring-form appearance which has given rise to the term by which it is known. There may be but one lesion or there may be dozens of varying sizes,  $\frac{1}{8}$  inch to 2 or more inches in diameter. Occasionally the smaller patches run together, forming large areas of irregular shape.

**Diagnosis.**—The diagnosis is usually not difficult. The characteristic well-defined ring, circumscribed and usually multiple, is not simulated by other skin diseases. In some cases in which the margin is not so well defined, and in those which show one or more circumscribed scaly areas, the lesion may be confused with a patch of seborrheic eczema.

Psoriasis may resemble ringworm. Psoriasis is, however, very rare in children. Furthermore, the lesions of psoriasis are usually located and grouped on the extensor surfaces and at the margin of the hair, and the scales are thicker and more abundant than those of ringworm. In patches of acute eczema the characteristic abrupt margin is absent, itching is more marked than in ringworm, and the inflammatory manifestations are changeable from day to day, while in ringworm the appearance of the lesion is without change. If doubt exists and the latter condition is present, a microscopic examination of the scales to which a few drops of liquor potassii have been added will reveal the presence of the long, delicate threads of mycelium and thus settle the diagnosis.

**Treatment.**—The treatment consists in the use of some irritant that will produce a desquamation of the superficial layers of the skin in which the fungus is located. The tincture of iodine has proved a satisfactory remedy whenever the lesion is located where its use is possible. Two or three applications of the U. S. P. tincture at twenty-four-hour intervals constitute all the treatment ordinarily required. If the case proves obstinate, 2 grains of the bichlorid of mercury may be added to each ounce of tincture of iodine. If the lesion is situated on the face or elsewhere on the exposed surface of the body, 5 grains of bichlorid of mercury may be dissolved in equal parts of alcohol and glycerin, 1 ounce each, and applied locally three or four times daily until a slight dermatitis results. A rapid cure follows this treatment.

#### TINEA TONSURANS (RINGWORM OF THE SCALP)

Ringworm of the scalp is of frequent occurrence in institutions for children, and is greatly dreaded because, when once it gets a foothold, it is most difficult to eradicate. In one personally observed epidemic there were over 100 cases. These cases were all cared for by nurses and orderlies who lived in the wards with the children, and not one case occurred in an adult. The susceptible age appears to be from the third to the tenth year.

**Etiology.**—Ringworm is due to the action of the trichophyton fungus. The disease, which is most contagious, is transmitted by exchange of caps, or by means of towels, brushes, combs, etc. The diseased hair, according to Crocker, when placed under the microscope, after being soaked in B. P. liquor potassæ for half an hour and gently pressed out under the cover-glass, presents the following appearance:

The hair may be seen bent like a green stick, while the free end is frayed out like a brush, and (with a power of at least 200 or 300 diameters) abundant conidia or spores, with scanty mycelium, may be seen to permeate the shaft, both downward to the root end and upward above the surface for some distance, this appearance differentiating the condition from favus. Between the inner root-sheath and the shaft the conidia are also apparent in great numbers, but the mycelium is less abundant in the hairs than in the scales. The conidia measure from 4 to 5 micra, and are round and sharply contoured, with a central nucleus like a black dot. The mycelium consists of well-defined, transparent, branched and pointed threads, terminating in conidia. They may be seen best in the shaft near the bulb or between and on the scales.

**Diagnosis.**—The diagnosis is not difficult. The circular circumscribed patch with the short "stubbles" of hairs on the otherwise normal

scalp is simulated by no other condition. The diameter of the involved area varies from  $\frac{1}{2}$  inch to 2 or 3 inches. A large denuded area is usually the result of the coalescing of smaller areas. There may be but one involved area on a scalp or there may be a dozen.

**Prophylaxis.**—To prevent an epidemic when the disease breaks out in an institution which is the permanent home of children is most necessary and yet most difficult. The only means of stopping the spread of the disease, in the writer's experience, has been in having the heads of all the unaffected children closely clipped and giving them a shampoo of equal parts of kerosene and olive oil twice weekly.

**Treatment.**—Cures are difficult, and the treatment must be along radical lines. In an epidemic several years ago at the Country Branch of the New York Infant Asylum, abundant opportunity was offered to test the various forms of treatment advocated by different observers. Among the applications used were chrysarobin in various combinations, carbolic acid, iodine, bichlorid of mercury, sulphur, and white precipitate.

The location of the fungus in the hair-follicle renders it very difficult to apply any drug so that it will be effective as a parasiticide. In order to accomplish this it is absolutely necessary to cut the hair of the entire scalp as short as possible. Upon beginning the treatment the scalp is thoroughly scrubbed with water and strongly alkaline yellow laundry soap, so as to remove all the dead hair and desquamated epithelium. The parasiticide to be used is then rubbed into the diseased area and for a considerable distance over the surrounding healthy scalp. The parasiticide which proved most valuable in the epidemic cited was composed of bichlorid of mercury, 2 grains in  $\frac{1}{2}$  ounce each of olive oil and kerosene. The bichlorid must be dissolved in a small quantity of alcohol before it is added to the oil mixture. This is rubbed into the diseased area every day until the scalp becomes sore and tender. In order to prevent the spread of the infection to other parts, the kerosene and olive oil without the bichlorid may be applied every fourth day, without friction, to the entire scalp. To effect a prompt cure it is necessary to produce a dermatitis at the site of the lesion. When this occurs, the treatment should be temporarily discontinued. As soon, however, as the dermatitis subsides another inflammation should be produced in like manner. After three or four weeks this treatment may be discontinued while the patient is still kept under observation, in order that the physician may confirm the results. A daily application of sterile oil aids in bringing the skin to a normal condition.

In treating one-third of the children in the epidemic referred to, 2 grains of the bichlorid of mercury were added to 1 ounce of the tincture of iodine. Twenty-six cases were treated by this method, with an average duration of treatment of eight and one-half weeks. Several recovered in four weeks, while for others twelve weeks of treatment were necessary. So long as the treatment is in progress the child should wear a cap, day and night. This may be made of any cheap, light-weight material, which, after a day or two of use, may be burned. In our cases cheese-cloth caps were used. Rubber gloves were necessary to protect the hands of the nurse who made the applications, especially if there were many heads to be treated.

In this epidemic, which was controlled by the above means, prophylaxis was obtained by the use of the kerosene and olive oil without the bichlorid. It was found impossible to maintain a quarantine permanently or effectually even for a short time, particularly during the warmer months. Therefore every inmate of the asylum of the "run-about" age who did not have the disease was treated as an incipient case. Every head was "clipped" and the hair kept short. Twice a week the children were given a kerosene and olive oil shampoo.

In private work the continued use of kerosene and olive oil is not popular, for reasons readily understood. In such cases the hair should be clipped as soon as the case is diagnosed, and a kerosene shampoo given. The bichlorid of mercury, 2 grains to 1 ounce of tincture of iodine, U. S. P., should be applied to the parts with sufficient vigor to produce a dermatitis. If the disease shows a tendency to spread beyond the original site, it is best prevented by the use of the kerosene and olive oil, in the manner above described. Bulkley<sup>1</sup> has contended that all cases are cured spontaneously at puberty, as practically no cases are seen in the scalp of the adult.

Strickler<sup>2</sup> reported favorably on the results in 20 cases of ringworm of the scalp treated by vaccines.

*Röntgen-ray Treatment of Ringworm of the Scalp.*—With many improvements in technic and apparatus x-ray treatment is now comparatively without danger and offers a very speedy cure. The treatment must be in the hands of experts.

The efficacy of the treatment is due to the falling out of the infected hairs carrying with them the organisms. There is no direct action on the parasite so that precautions must be observed after treatment to prevent the infection of others by the falling hair. This is easily accomplished by keeping the head covered. About seven days after x-ray treatment a local erythema develops, lasting three to four days. The hair falls out about the end of three weeks and begins to regrow in three months. No local treatment is used two weeks prior to treatment and for one month afterward, when a 5 per cent. ointment of sulphur or of ammoniated mercury U. S. P. is applied.<sup>3</sup>

### IMPETIGO CONTAGIOSA

Impetigo contagiosa, as the name implies, is a contagious disease of the skin. Several children in the same family or school often have the infection at the same time. One school child has been known to infect an entire class of 20. Cases of impetigo are seen almost daily in large out-patient clinics for children. The exposed parts comprising the face, head, and hands are those most frequently involved.

*Etiology.* Bacteriologic examination shows a mixed infection with staphylococcus predominating.

*Symptoms.*—At first the lesion consists of a few closely grouped vesicles, which rapidly develop into pustules. These shortly form a

<sup>1</sup> Jour. Amer. Med. Assoc., July 17, 1915.

<sup>2</sup> Ibid., August 17, 1912.

<sup>3</sup> For complete details of technic consult Mackie and Remer, Medical Record, New York, and Lippincott, p. 247.

dry crust of variable size and thickness. One area or a dozen or more may be involved. Several small lesions may coalesce, forming one large lesion, the crusts of which may be 2 inches in diameter. They rest upon an inflamed base, which bleeds slightly when they are removed. There are no constitutional symptoms, and rarely is there itching. The only evidence of the disease is the disfigurement occasioned by the dry, adherent crusts.

Impetigo may occur in the form of *ecthyma* in which the lesions are red and nodular involving the deeper layers of the skin and developing into pustules with a tendency to resultant scars. The lesions in *ecthyma* are always discrete and tend to affect the extensor surfaces of the legs and the buttocks. The tendency of this condition to follow scabies is noteworthy.

**Treatment.**—A most satisfactory procedure has been to soften the crusts by the application of gauze saturated with sterilized olive oil, the gauze being bound to the parts. Usually in twenty-four hours the crusts may readily be removed. Afterward an ointment of 2 to 5 per cent. ammoniated mercury or 10 per cent. boric acid in ointment of rose-water, or one composed of 10 per cent. ichthyol in vaselin, should be spread on sterile gauze and bound to the suppurating surface. The dressing should be changed at least night and morning. Recovery is usually complete in from two to three days. When the crusts are on the lip or other portions of the face where the dressing described cannot readily be applied, the lesions should be kept moist with either the boric acid or ichthyol ointment. If the gauze is not used, fresh ointment should be applied at least every three hours, both before and after the crusts are removed.

In the *ecthymatous* type of impetigo the cure is more difficult and the ointment applications must be preceded by wet dressings. For this purpose aluminium acetate is recommended.

### PEMPHIGUS NEONATORUM

Pemphigus in the newborn is an infection of the skin manifesting itself in a bullous eruption, which may appear on any portion of the surface. Two epidemics of pemphigus at the New York Infant Asylum involved in all about 30 cases. The patients were mostly well-nourished infants. The origin of the disease in each epidemic was unknown. From a few hours to a day after birth bullæ of the seropus appeared, and in several cases the process was so extensive through their coalescence that large portions of the skin surface were denuded when the bullæ ruptured.

The disease is very contagious, and these epidemics were only stayed by rigid quarantine of all the newborn and by closing the operating-room. Examination of the serum from the bullæ of several cases showed *Staphylococcus albus*.

The mortality was about 20 per cent.

**Treatment.**—The management of the first epidemic consisted in opening the blebs and in the application of various antiseptic solutions and ointments. Not much improvement followed until creolin baths were used. This treatment not only relieved those cases which had developed, but the systematic bathing in a 1 per cent. creolin solution

of all the newborn in the institution apparently prevented the spread of the infection.

During the second epidemic the house physician, Dr. Carswell, ascribed favorable results to a 30 per cent. solution of ichthyol kept applied to the parts and changed three times a day.

### ERYTHEMA NODOSUM

Erythema nodosum is characterized by the formation, in the skin and connective tissue, of multiple brownish nodules of varying size.

**Location of the Lesion.**—The nodules are most frequently seen over the anterior surface of the leg.

**Etiology.**—The disease is to be regarded as an infection, most probably one of the many protean manifestations of rheumatism. In our cases endocarditis has not been a complication, although all the patients have been rheumatic subjects, and in some cases exhibited peliosis rheumatica.

**Symptoms.**—Previous to the appearance of the nodules there may be fever and loss of appetite and general indisposition on the part of the child. According to our observation these prodromal symptoms have, however, been unusual, the local manifestations constituting in some cases the only evidence of the disease. The nodes are very painful to the touch, and show a black and blue discoloration. The entire anterior surface of the tibia may have a bronzed appearance.

Pigmentation follows the disappearance of the nodules.

In mild cases the pain is confined to the lesions. In severe attacks there is not only fever but also a great deal of joint pain and muscle soreness.

**Treatment.**—If there is fever, the patient should be kept in bed until the acute febrile period is passed and the nodules begin to disappear. The treatment is begun with the administration of 1 or 2 grains of calomel, followed by a saline laxative.

Milk and a vegetable diet are prescribed. A very small amount only of sugar is permissible. As a rule, apparently the best results from drug therapy have been gained by the use of 5 grains of the salicylate of soda in combination with 10 grains of sodium bicarbonate in 6 ounces of water after meals.

*Illustrative Case.*—A delicate girl had three crops of nodules, the different crops having appeared at intervals of about three months. The first attack was associated with peliosis and urticaria. This patient who was markedly rheumatic, had taken large quantities of the salicylate, and its readministration contrary to experience with other cases, had no effect; but in all three attacks the nodules began to diminish and disappeared completely under the administration of 30 grains of iodid of potash daily.

The duration of the cases has been from ten days to three weeks, with the exception of the one referred to, which persisted for six weeks, until the iodid was brought into use, when the improvement was prompt.

**Local Measures.**—A most satisfactory local application for the relief of pain is the lead and opium solution, U. S. P., applied warm to the parts by means of soft old linen or gauze, over which oiled silk or rubber tissue is placed to prevent too rapid evaporation, the entire dressing being held in position by bandages.

## ERYTHEMA MULTIFORME

As its name indicates, this is a disease of the skin manifesting itself in many different forms.

**Etiology.**—It is most frequently encountered in ill-conditioned children of rheumatic diathesis, and is frequently associated with disorders of digestion and the toxic action of various drugs, particularly those derived from coal-tar.

Exceptionally a rash of this type is observed in prolonged subacute infections such as colon bacillus pyelitis.

**Symptomatology.**—The disease usually manifests itself in reddened papules, macules, and erythematous, infiltrated skin areas, all of which are most frequently found over the dorsal surfaces. There is no pain and but little if any itching.

**Diagnosis.**—The condition is to be differentiated from acute urticaria by the fact that in urticaria the lesions are very transient, appearing and disappearing rapidly, while in erythema multiforme several days are required for resolution to take place.

**Treatment.**—The management consists in relieving whatever digestive derangement may exist by the use of calomel, rhubarb and soda, and the enforcement of a suitable diet (pp. 134-136).

For a child five years of age 3 grains of salicylate of soda with 6 grains of bicarbonate of soda in 4 ounces of water should be given after meals three times daily. In the event of itching, which is unusual, an ointment composed of 10 grains of menthol in 1 ounce of rose-water ointment will usually furnish relief. The eruption seldom lasts longer than a week. A pigmented area may remain at the site of the lesion.

## HERPES SIMPLEX (FEVER BLISTERS)

An eruption of small vesicles on a reddish edematous base is not infrequent about the lips following some constitutional disturbance associated with fever. The cheeks as well as the perioral region are at times affected. Herpes genitalis is a similar affection not often observed in children.

**Etiology.**—The lesions are probably due to the activity of bacterial toxins. Pneumonia, meningococcus meningitis, and malaria may be accompanied by herpes of this type. The exact cause of the condition is unknown.

**Pathology.**—The vesicles are deeply situated and may be entirely beneath the epithelium. They become filled with clear fluid and their development is associated with localized hyperemia. Degeneration and necrosis of prickly cells in the affected region is an accompaniment. Suppuration may occur, but ordinarily the vesicles undergo desiccation without rupture and without scarring.

**Symptoms.**—Itching and a sensation of tension and soreness locally comprise the chief subjective symptoms. The nature of the lesions is readily apparent to the eye. Temperature elevation and more serious symptoms are dependent on the underlying constitutional disturbance with which the herpes is associated.

**Differential Diagnosis.**—The distribution of the lesions and their self-

limited duration—about a week—serve to distinguish herpes from vesicular eczema and impetigo even when the character of the herpes is atypical. The vesicles of eczema are characteristically thinner walled and rupture more readily than those of herpes.

**Prognosis.**—One attack seldom lasts more than a few days. Recurrences, however, are not uncommon.

**Treatment.**—Astringents, such as spirits of camphor, alum in 2 per cent. solution, and alcohol may be applied locally. When there are fissures silver nitrate in 10 to 20 per cent. solution is invaluable.

#### HERPES ZOSTER (SHINGLES; ZONA)

An acute inflammatory disease productive of vesicles in large numbers similar to those of herpes simplex not infrequently attacks the skin along the course of one or more sensory nerves.



Fig. 112.—Thoracic herpes zoster (Bellevue Hospital).

**Etiology.**—This disease is looked upon as an acute specific disease of the nervous system with secondary effects in the skin. The posterior ganglia of the spinal cord typically exhibit lesions microscopically in the abdominal and thoracic types, while in herpes affecting the head the gasserian ganglion may be involved. Chickenpox virus, syphilitic virus, and diplococci and streptococci have all been considered causative, and in some instances diseased tonsils and teeth probably are foci of origin for the infection to which the herpes is indirectly due. Exposure to cold, productive of diminished resistance, and the long-continued use of arsenic are further causes.

**Pathology.**—The vesicles are deeply seated and contain serum, degenerated prickle cells and leukocytes, and rarely blood. The degenerative changes occurring in the posterior ganglia cells have already been mentioned. There is apparently a close analogy between the effects of this disease, dependent on sensory nerve root lesions and those of poliomye-

litis due to motor cell degeneration in the anterior cornua. Neuralgic pains in herpes, rather than sensory paralyses, are, however, the rule.

**Symptoms.**—In children pain of a severe character is less frequent than in adults. In fact, very little if any discomfort may be manifested. This is usually limited to itching and local soreness. Infrequently adjacent lymph-nodes may present slight involvement. The most common sites for the lesions are along the course of the thoracic, lumbar, brachial, and supra-orbital cutaneous nerves. (See Fig. 112.) At times the gluteal region may be affected.

Recurrent attacks of herpes in this region were observed in association with gastrointestinal overloading and asthma in a little girl.

The lesions may be few or numerous and develop in successive patches for days. The acute condition usually subsides with the characteristic desiccation stage within a fortnight of the onset.

Exceptionally, bilateral shingles may occur.

**Diagnosis.**—The distribution and character of the eruption is diagnostic, particularly when neuralgic pain is an accompaniment.

**Prognosis.**—Recurrences in the same patient are unusual. The worst effects of the disease have been apparent in eye involvement and meningitis following zoster of the supra-orbital region.<sup>1</sup>

**Treatment.**—Repeated doses of phenacetin or aspirin are of value during the height of the attack.

Locally the wax treatment as applied to burns has been endorsed by Fox. Dusting powders such as dermatol, aristol, and nosophen may be employed to hasten desiccation. In the event of suppuration the vesicles may require puncture and drainage.

## ERYSIPELAS

Erysipelas is a serofibrinous inflammation of the skin, and may go on to the stage of gangrene. It is caused by the streptococcus, which enters through a wound or abrasion and spreads along the lymph-channels.

In newborn infants the umbilicus may be the point of entrance for the streptococcus, and erysipelas of the surrounding portions of the body wall may result.

**Etiology.**—Infants with low resistance are predisposed. Nevertheless, babies ideally cared for are sometimes victims of the infection. The absence of resistance of the young to bacterial invasion is unquestionably a factor in determining the age incidence.

**Mode of Entrance.**—In the newborn the streptococcus may enter the skin by the nasal route, or the navel may be the seat of the initial infection. Later in development the process may begin in any portion of the skin surface. The scalp and the female genitalia are favorite sites.

*Illustrative Cases.*—In a fatal case the infection developed at the site of an incompletely healed chickenpox lesion on the upper anterior chest.

In another case which proved to be mild in spite of severe temperature manifestations the rash extended over the cheek from a suppurating mastoid wound.

<sup>1</sup> Sutton, *Diseases of the Skin*, 5th ed., 1924, p. 274.

**Symptoms.**—The onset may be marked by a convulsion. The first sign may be high fever, the cause of which is not known until a reddened, indurated area with sharply defined border is found at some point in the body. The infection, when not very severe, may invade the scalp and continue to spread unrecognized because of the protection of the hair. Usually a considerable area, at least 2 or 3 inches in diameter, will be present when the disease is discovered. From this primary area there is a slow progressive spreading of the process, the margins of the affected zone remaining sharply defined. The inflammation may be arrested at any point or may involve the entire body. The slowly creeping red line of demarcation sharply defines the normal from the reddened infected skin. The skin over the feet and hands may be swollen almost to the point of rupture. Severe infections are never followed by recovery. If the case is mild, the general process will be less intense, the creeping extension less rapid, and the response to treatment more prompt, permitting recovery.

The temperature is very high—usually 104° to 106° F.—with but little variation. The height of the temperature is indicative of the severity of the infection. In mild infections only, the fever may be slight.

With erysipelas the child is very uncomfortable and restless and cries much, giving evidence of considerable pain, particularly upon manipulation.

**Complications.**—Erysipelas does not predispose to any particular form of illness. Patients who resist the infection may develop bronchopneumonia as a terminal complication.

More often the digestive system becomes involved, the child loses weight rapidly, and dies from exhaustion.

A complicating meningitis is not an infrequent cause of death.

**Prognosis.**—Erysipelas is a particularly fatal disease in infants. In the newborn 95 per cent. of the cases are fatal. Fifty per cent. of the senior author's cases occurring in children under one year of age have been fatal. At Bellevue Hospital, where a considerable number of these cases are treated, the disease has appeared to be less fatal in the infants who were breast fed. When the streptococcus of erysipelas gains entrance into the skin of an infant, it is not unusual for the entire skin surface to become involved before the process subsides. The long-continued high temperature, the toxemia, the discomfort from the inflammation, and the interference with nutrition so greatly reduce the patient that even if the disease is resisted during the acute stage the subject is very apt to die later from exhaustion.

This was the outcome in 4 cases observed at the New York Infant Asylum, where each child went through the active period of the disease, but died a week or two afterward from exhaustion and marasmus.

**Treatment.**—The treatment is unsatisfactory, particularly so in young children. The younger the child, the graver the prognosis. Absolutely nothing is to be promised. Scarifications in advance of the line of the slowly creeping inflammation have been employed and whether solutions of the bichlorid of mercury, carbolic acid, or ichthyol were used as a dressing, the red line has been observed to pass the scarified, disinfected

surface regardless of the nature of the antiseptic and regardless of the vigor and vitality of the child.

The termination of the case, whether in recovery or death, depends to a great extent upon the resistance of the patient and the severity of the infection, so that our first step should be to place the child in the best position to resist the disease.

*General Measures.*—Particular caution should be exercised by attendants in caring for this disease both to avoid infecting themselves and to avoid conveying the infection. The care of obstetric and surgical patients should always be conducted by those who are not attending erysipelas cases. Perhaps the most important factor in the treatment is abundance of fresh air. In the winter the child does best in a room with windows wide open, not for a few moments at intervals, but continuously. Protection with hot-water bags and sufficient clothing eliminates danger as long as the temperature of the room does not fall below 55° F. At other seasons of the year the patient should, if possible, be kept out-of-doors.

Infants with erysipelas are particularly liable to develop gastro-enteric disorders. In case the child is bottle fed, the milk mixture should at once be reduced from 50 to 75 per cent. below the normal by the addition of barley-water or Granum-water No. 1, so that the amount of fluid given at a feeding remains unchanged.

Internal medication, such as we have used, has been of no value unless stimulating or sustaining in nature. The tincture of the muriate of iron is not to be given young infants with erysipelas, for it almost invariably disturbs the appetite and interferes with the digestion.

In the event of high temperature—above 104° F.—the cool pack (p. 841) may be found effective.

*Local Applications.*—The local agent which is unquestionably of some value is ichthyol. We prefer a 30 per cent. solution if the involved area is on one or more of the extremities or a small portion of the trunk. Strongly antiseptic solutions as dressings should not be used for infants when the erysipelatous process involves the face or much of the trunk. When these parts are involved, a dressing of 30 per cent. ichthyol ointment in vaselin should be applied on strips of lint or linen and renewed every three hours. The frequent renewal is important, and the ointment-dressing should be used only on the acutely involved areas. When, in a given case, the inflammation begins to subside, the dressings should be removed and the parts bathed freely. In this connection it must be remembered that the skin is an important organ of excretion, particularly of carbon dioxid. The constant covering of comparatively large surfaces on a small body, by interfering with the function of the skin, may become a serious matter. The local treatment with ichthyol should follow up the extension of the inflammatory process and be continued until it subsides. Of later years we have been using with a fair degree of success a cool wet dressing of a saturated solution of boric acid. The lotion is applied on old linen or several thicknesses of gauze. The parts are kept continually wet with the solution day and night.

*Stimulants.*—Nearly every infant with erysipelas will require stimulation. For this purpose small doses of whisky well diluted appear best.

From 5 to 15 drops at two-hour intervals for children under two years of age has aided, the writer is sure, in carrying patients through to a successful convalescence. Erysipelas is the only disease in which it is wise to use alcohol early, and in many instances as the only stimulant.

*Convalescence.*—When the inflammation subsides the child is by no means to be regarded as well; for even in the absence of sequelæ, such as a phlegmon, endocarditis, or nephritis, vitality may have become so reduced that sudden death may take place when it is thought the patient is well on the road to recovery, such a result being due, perhaps, to unrecognized myocarditis. During the entire attack and throughout convalescence the child should be fed to the limit of digestive capacity, but never beyond this limit. Correct feeding is possible only by careful observation of the case and frequent inspection of the stools.

*Specific Therapy.*—The value of vaccine and serum therapy in this disease remains to be proved. (See p. 862.)

### DERMATITIS (ECZEMA)

The term "eczema" should be removed from the nomenclature of skin diseases and "dermatitis" substituted. A lengthy discussion of this subject is left to the dermatologist.<sup>1</sup> We have seen enough of the so-called eczema in thousands of cases to warrant our belief that the lesion as we find it in the skin of infants and children is the expression of an abnormality in the bodily function, on the one hand and, a reaction to local extrinsic irritation on the other. Dermatitis (as we prefer to call it) can be successfully treated by local measures only in those cases due to extrinsic local causes. It is the problem of the physician to find out the deranged processes (usually chemical, physiologic, or allergic) to which the dermatitis is a reaction. If we group together all the skin diseases of infancy and childhood, it will be found that this affection considerably exceeds in prevalence all the others combined. This is not surprising when we remember the exposed situation of the skin, its delicate structure, and its manifold functions of absorption, secretion, excretion, and heat radiation.

*Etiology.*—Grossly as it occurs in infants dermatitis may be divided into two types: the first, due to causes operating from without the body, including local infection of various kinds or local irritation of whatever nature; the second, due to abnormal systemic conditions affecting the skin through the nervous system or by means of the blood-current. Cases of this latter class are looked upon as of toxic origin. The irritation of the skin or the skin lesion is actually the secondary manifestation of a disordered constitutional state. Upon the non-resistant skin lesion infection is implanted through exposure to the air or through scratching, and the result is a form of dermatitis in which both causes are operative. This is the etiologic explanation of the majority of the cases in patients under two years of age.

<sup>1</sup> "The present tendency is to exclude, as rapidly as possible, all forms of dermatitis which have a definite cause, and which upon removal of this cause disappear. Eczema is a dermatitis and it is not possible to say in every case which title is the more appropriate. A convenient division classes under dermatitis those forms of involvement of the skin which result from recognized external causes and which subside upon removal of the cause," Ormsby, *Diseases of the Skin*, 2d ed., 1921.

In view of the foregoing it is plainly not possible, even were it desirable, to make the attempts at differentiation, such as is found in textbooks dealing with dermatology in the adult. Repeatedly one will find a weeping or catarrhal skin reaction in one portion of an infant's body and on other portions every variety of inflammatory lesion, including papules, vesicles, pustules, and fissures. Moreover, a weeping surface may be replaced by perfectly normal skin within a day or two and then suddenly return within a few hours following some dietetic indiscretion.

Infection of the involved areas by pyogenic bacteria, resulting in pustules and furuncles, is more common in infants than in adults, because of the child's tendency to inoculation through manipulation and scratching, and because of the diminished resistance offered by a child to pathogenic organisms.

*Toxic Origin.*—The cases that are due to disordered metabolism, digestive derangements, or protein allergy are the most frequently encountered and by far the most resistant to treatment.

*Age.*—The susceptible age is from one to twelve months. While cases which have developed during the earlier months of life may persist into the second and third years, so long a duration is comparatively rare, and it is equally rare for cases to develop after the first year, the latter fact implying that many are cured spontaneously.

*Physical Condition.*—The physical condition and vigor of the child exert apparently little influence upon the development of the disease. In many instances, however, it has been aggravated during active dentition. Some of our healthiest nursing babies who have made most satisfactory progress and have been well in every other respect have been sufferers from dermatitis until the nursing period was over or until nursing was discontinued and other food given. In fact, the majority of our cases have occurred in children whose condition was otherwise satisfactory. There have been other patients, to be sure, who have suffered from malnutrition or been difficult feeding subjects. In some of these dermatitis was possibly a factor in causing the malnutrition, for on account of the excessive itching and consequent restlessness and sleeplessness, strength had become so markedly reduced that malnutrition was just as probably a result as a cause of the skin condition. Nevertheless, a consideration of all the cases encountered indicates that athreptic and poorly nourished children are surprisingly free from manifestations of an acute inflammatory type. Whatever process is at fault is usually of such a nature as not to interfere with nutrition.

In a considerable proportion of the cases there is apparent an associated dermatitis of the scalp.

Several of our patients who have been sufferers from "eczema" in babyhood have in later life developed some tendency to cyclic illness, such as recurrent bronchitis, recurrent asthma, or recurrent (cyclic) vomiting. Not a few patients have been the offspring of parents who gave a history of gout or rheumatism.

*Suboxidation.*—Incapacity for the oxidation of cow's milk fat and sugars has been the cause of persistent dermatitis in many of our cases. This has been proved clinically by the simple procedure of withdrawing these substances and using a sugar-free diet and fat-free cow's milk. The milk-

sugar in the cow's milk can be taken care of by the patient. In many cases this simple treatment has been followed by recovery. In such infants there is an apparent low type of so-called acid intoxication. These patients further do best when the alkaline reserve balance is supported by the administration of bicarbonate of soda or magnesia. The carbohydrate as it exists in cereals, vegetables, and fruit appears to exert no influence on these cases. Cod-liver oil in moderate doses is usually well tolerated. It is a peculiar fact that in dermatitis of the metabolic type orange juice and beef juice will start a conflagration of weeping and itching.

The ingestion of fats and cane-sugar may be an important etiologic factor in causing dermatitis in the young. Carbohydrate in the form of baked flours appears to exert but little influence. Orange juice and beef juice, however, when given in association with a high sugar diet will precipitate an attack in some children or produce recurrence in a recovered case.

*Protein Sensitization.*—Allergy to human milk, or more frequently to cow's milk, is responsible for many cases. Infants belonging to this group are those who at some time in infant life or in the runabout period or even later, give evidence of the existing sensitivity through the respiratory tract by a tendency to bronchial spasm during bronchitis, or the development of true asthma.

Children who are neglected and generally badly fed often have a persistent dermatitis with no apparent relation to any specific cause. When the hygiene and diet of these children are corrected the dermatitis disappears. Not all cases admit of a cure and yet quite possibly nearly all cases might be cured if we dared draw our dietetic lines sufficiently rigid. This might mean a clear skin, but it also might mean faulty growth and malnutrition. Now and then an infant cannot be maintained free from the dermatitis because of loss of weight occasioned by the necessarily restricted diet. In such cases proper growth and right development are more important than personal appearance.

*Local Irritation as a Factor.*—Traumatic dermatitis may be produced by any form of irritation, such as woolen worn next to the skin, counter-irritants applied for therapeutic purposes, overclothing in hot weather, or scratching to relieve the itching caused by the bites of insects. In fat babies, portions of whose skin surfaces are in constant contact, sufficient irritation is produced by friction and perspiration to produce an active localized dermatitis.

*Symptoms.*—The symptoms cover so wide a field that a description is most difficult. A red, inflamed area on the cheek and an extensive acute general dermatitis constitute the two extreme possibilities of the acute lesions. Between these extremes there is every degree of involvement.

When an infection with the staphylococcus supervenes we may expect all possible varieties of pustules and furuncles, and the case may show, throughout, the characteristics of chronic dermatitis in the adult: dry, scaly, desquamating epithelium on extensive reddened surfaces, or infiltrated skin areas with diffuse macules and papules and abundance of scratch-marks. The extensor surfaces of the arms and legs are the most frequent sites of election by this form.

**Prognosis.**—This is one of the diseases that requires patient and persistent treatment. The prognosis is then good, and the results fairly prompt, but always commensurate with our ability to discover the morbid factor which is the occasion of the skin reaction in constitutional cases. The disease in its severe form does not tend toward recovery, particularly during the first year, although many cases developing during the first month terminate in cure spontaneously during the second year. In a few subjects the tendency persists during the lifetime of the individual.

Our most difficult patients are often overfat babies, for the dermatitis is a reaction due to abundance and not a feature common to starvation. In fact, it is exceedingly rare to find an active constitutional dermatitis in a marantic or undernourished infant.

**Treatment.**—The management is variable, depending upon several factors.

The protein-sensitive cases may be controlled not so readily through immunization, which has accomplished little as a rule in this disease, as by keeping the patient apart from the offending substance. The cases due to fat and sugar incapacity are the most difficult to control, for reduction in these food elements may mean failure to gain or loss in weight, a state more serious than the dermatitis. It is fortunate that, as has been stated, many infants adapt themselves to the causative factor and get well spontaneously after the first year.

*Management of the Breast Fed.*—If the child is a well-nourished, breast-fed baby and presents the familiar picture of the red, weeping cheeks, with dry crustations extending to the forehead and ears, seborrhea of the scalp, and roughened skin over the outer aspect of the arms, the first step is to look into the life and habits of both child and mother. Her own life and the nursing hours are to be regulated along the lines laid down under Maternal Nursing (p. 45). A most important requirement of these cases is that the mother's bowels shall be evacuated at least once daily and that the same function shall take place in the baby. In a case of the character described the child has usually been getting too much food, and probably food high in fat. The mother's milk should be examined and the baby weighed before and after nursings for twenty-four hours in order to determine the amount of milk taken at a feeding. As a general observation it will be found that these infants do best on four-hour nursings, at 6 and 10 A. M.; 2, 6, and 10 P. M. If the mother's milk is found to contain an excess of fat, 1 ounce or 2 of water or barley-water should be given before each nursing to diminish the amount of fat ingested.

For the correction of constipation in the mother we may prescribe the following laxative:

R.	Ext. belladonnæ.....	gr. iv
	Ext. nucis vomicæ.....	gr. viij
	Ext. cascariæ sagradæ.....	ʒij
	M. Div. in capsulas no. xxx.	
	Sig.—One at bedtime.	

By applying this form of management to the mother and child we have repeatedly known the dermatitis to subside very promptly. In

other cases we have seen it improve; and in still others persist without the slightest benefit.

The problem which confronts us may be rendered difficult in different ways. If the child is her first offspring, the mother feels keenly the disfiguring condition and demands a prompt cure. If this is not forthcoming within a few weeks she seeks new medical advice. An excellent rule for the persistent breast-fed cases is for the mother to continue to nurse the thriving child and tolerate the dermatitis. Local treatment should be prescribed to relieve as much as possible the child's distress. The mother may be told that at the time of weaning the unsightly skin condition will probably disappear. If weaning is insisted upon, the patient forthwith becomes a bottle-fed infant and is treated accordingly. The dermatitis often, but not invariably, clears up promptly when nursing is stopped.

*Management of the Bottle Fed.*—Every year we see many aggravated cases of dermatitis in bottle-fed babies who have been treated elsewhere, often by dermatologists, without benefit. Failure usually has been due to the fact that while a great deal of attention has been paid to local measures, little if any has been directed to the feeding and other details of the constitutional care.

The value of local applications in the form of lotions, ointments, and powders in the treatment of so-called eczema in childhood depends solely on their protective function and their sedative effect. Local treatment, furthermore, is attended with disappointment. The external condition may be temporarily relieved in a marked degree, but if the underlying systemic toxic condition exists, the disease returns with renewed vigor.

The skin tests have helped us but little for the reason that most of the susceptible infants are so sensitized to fresh cow's milk as to exhibit a dermatitis without reacting positively to the laboratory skin tests. However, there should be a skin test for allergy to whatever milk foods are used, and to the cereal flour which is added. Such infants should also be tested for the usual cereal starches and simple vegetables which are to be added early to the diet to make up in a measure for the deficiencies occasioned by the special manipulation of the milk mixture. Such infants may be generally well and thriving, yet with a distressing dermatitis. When they discontinue cow's milk or are given a milk that has been partially or entirely inactivated through heating or drying the dermatitis disappears. In most cases we are consequently unable to learn positively the nature of the irritant, and inasmuch as it is either due to a fat or carbohydrate incapacity or is derived from protein sources we prescribe a food of low sugar and fat content, and so treat the protein as to completely or partially eliminate sensitizing possibilities. For this purpose we employ dried milk or evaporated milk. The latter is to be cooked for an hour or more, as a prolonged heating period appears to render the protein irritant less active. Some children will do better on a fat-free milk which is cooked in a double boiler at least two hours, water being added to replace that lost by evaporation.

Certain of the commercial dried milk foods appear to have been thus inactivated. For example, in chronic dermatitis one of the dry milks may be given with advantage as a milk substitute.

*For practical purposes in routine feeding we may assume that the baby with persistent active dermatitis has a low fat and low sugar capacity and exhibits a reaction to fresh cow's milk protein.* Our feeding plan for a hypothetical patient six months old and weighing 14 pounds then calls for a formula as follows:

8 ounces of evaporated milk,  
27 ounces of water,  
2 ounces of barley flour,  
1 ounce of granulated sugar.

Give 7 ounces every four hours.

Instructions are given that the entire mixture is to be cooked together in a double boiler for one to two hours with water added at the completion of the cooking to make up for that lost in evaporation. A rather thick mixture is produced which may necessitate a large opening in the nipple. If constipation results, milk of magnesia may be added to the entire mixture when not hot, in sufficient amount to produce an evacuation daily. There will probably be no gain in weight and little if any loss. The milk proportion should then be increased an ounce or two if the child is not satisfied.

*Illustrative Cases.*—A baby otherwise normal had a most pronounced general dermatitis, the entire skin surface being involved. For seven months—until he was past one year of age—it was found impossible to give this patient more than 1 per cent. of fat. An increase to 1.5 per cent. of fat would be followed in half an hour by intense inflammation and redness of the skin.

In another case almost as severe, at the ninth month, it was impossible to give plain milk in any form. The condition was so aggravated that the writer discontinued entirely the fresh cow's milk and gave the child only evaporated milk, whereupon the skin cleared up promptly without any other treatment whatever. After about six weeks a further trial of whole milk in small quantities was at once followed by a prompt return of the dermatitis. At different intervals the plain milk was given for one or two feedings daily, but this we were always obliged to discontinue, because of the signs of the old trouble which immediately reappeared after two or three of such feedings.

In treating these obstinate cases, as the urine is usually very acid and a deposit of urates will be found on the napkin, it is advisable to give bicarbonate of soda, 1 grain to 1 ounce of food, or 10 grains of citrate of potash five or six times daily. Citrate of potash in fairly large doses, 5 to 10 grains every two hours, appears to be a valuable aid during the acute stage, yet may be discontinued after the erythema and weeping has subsided.

If a high fat feeding has been practised, cure may at times be effected simply by the use of full cow's milk, with the gruel diluent.

The successful management of non-traumatic dermatitis depends upon our ability to discover the disturbing food factors, to eliminate them if we dare, or if possible immunize the patient to such food or foods.

*Local Treatment.*—In view of what has been said, little is to be expected from local measures. As a rule, too strong lotions and ointments are employed and help to keep up the irritation, producing harm rather than benefit. Vaseline is often used as a base, and this in itself is irritating to many skins. In facial eczema of an active type in young infants, however, the parts should be protected from scratching and pillow-rubbing. This is best accomplished by the use of a mask (p. 649) under

which are placed strips of old linen on which the following paste ointment is applied:

R. Pulv. zinci oxid,  
 Pulv. amyli.....āā 3ij  
 Ungt. aq. rosæ.....q. s. ad. 3ij

This ointment should be freshly applied three times daily. The child's skin is not to be bathed with water, but cleansed with sterilized sweet oil. When the weeping has subsided, some preparation of tar may be employed. An ointment composed of unguentum picis, U. S. P., 1 part, with unguentum aquæ rosæ, from 4 to 6 parts (the strength used depending upon the irritability of the skin), may be applied with much benefit morning and evening. The ointment should be thickly spread over old linen and held firmly, yet without great pressure, over the parts. If the existing irritation is at all increased, the amount of tar used must

be diminished. If the itching is considerably relieved by the application, 5 grains of menthol or 5 grains of salicylic acid may be added to each ounce of the ointment.

For localized areas of persistent chronic dermatitis x-ray therapy is particularly indicated. The results following only one or two treatments are often gratifying.

For the weeping or intensely inflamed surface euresol (Merck) has afforded great benefit. In this stage this remedy is best used in a solution of 1 to 3 per cent. The solution is to be applied very gently and allowed to dry. It may be applied at intervals of three to four hours. When the weeping



Fig. 113.—The Herty mask in position.

ceases and the skin becomes dry and desquamating an ointment of euresol 1 to 2 per cent., in unguentum aquæ rosæ, applied three times daily often contributes very substantial relief.

The application to obstinate dermatitis areas of undiluted refined coal-tar, over which talcum is freely dredged, often produces marked improvement in the skin condition in addition to relieving the itching. This application is, however, unsightly and finds greatest favor in the treatment of lesions in unexposed portions of the body.

*Bathing.*—No infants or young children suffering from generalized eczema should be bathed. Water is a decided irritant to the skin. For cleansing purposes during the acute stage sterilized olive oil or liquid petrolatum may be used. When the skin permits of bathing, the patient should have the advantage of the soda or bran bath (p. 844). Unnecessary friction is to be avoided at all times.

*Clothing.*—It is an excellent custom to have the clothing which comes in contact with the skin lined with thin linen. Wool worn next to the skin will frequently retard recovery.

*The Mask.*—The itching produced by facial dermatitis is often most intense. In order to effect a cure, scratching and rubbing the parts must be prevented. The Herty mask (Fig. 113) fulfils this purpose admirably. The ointment or lotion is placed on clean linen, which rests on the involved parts, and over this is placed the mask, a pattern of which is shown in Fig. 114. Opening A is sufficiently large to furnish space for the eyes, nose, and mouth. An elastic band, passing over the upper lip, draws the sides of the opening together, insuring protection to the cheeks, which are usually most severely affected. B and C pass over the ears to the back of the head, where they are united. The mask, which should be made of muslin or thin old linen, is to be renewed daily.

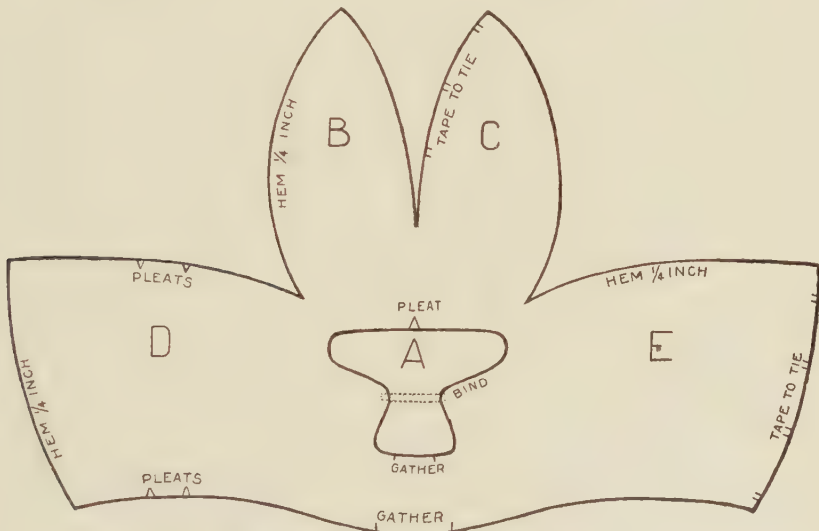


Fig. 114.—Pattern for the Herty mask.

The mask has been of much assistance in protecting acutely inflamed areas. It is useless to attempt the treatment of severe facial dermatitis without a protection of this nature.

#### TRAUMATIC DERMATITIS

The successful management of eczema due to external causes consists in the removal of the source of the irritation. In some cases lining the underclothing with old linen or the use of linen mesh underwear will solve the entire problem. Local treatment, when necessary, is afforded by the soothing or stimulant applications previously described.

Various remedies have been prescribed for the itching. The following lotion is often of service:

R.	Phenolis	gr. v
	Calaminæ præp.	ʒij
	Pulv. zinc oxidi	ʒij
	Glycerini	fʒij
	Liq. calsic	fʒss
	Aquæ rosæ	q. s. ad. fʒiv
M.	Sig.—Apply locally.	

An ointment in common use is composed as follows:

R. Mentholi.....	gr. v
Acidi salicylici.....	gr. x
Ung. aquæ rosæ.....	$\frac{3}{4}$ ij
M. Sig.—Apply locally.	

#### INTERTRIGO

This form of dermatitis is an affection resulting from persistent irritation due to moisture or friction. The primary condition of maceration soon develops into a chronic inflammation. This occurs with greatest frequency in fat children, but may develop in any child through neglect. In fact, intertrigo is often a mark of ignorance and neglect.

**Location.**—The parts most affected are the lower abdomen, the inner aspects of the thighs, and the buttocks. In neglected cases the process may involve the entire skin surface from the umbilicus to the lower third of the thigh. Other parts usually found affected are the skin folds of the neck, the groin and axillæ, and the flexor surfaces at the elbow-joint where contiguous portions of skin are subjected to chafing.

Neglected, athreptic, and poorly nourished babies afford many of these cases. Among out-patients have been seen infants who presented a series of linear ulcers in the groin, productive of entire destruction of the skin. In a few such instances resulting infection of the glands in the groin has produced an inguinal adenitis.

**Prognosis.**—All cases end in prompt recovery if proper care is exercised in carrying out the suggestions offered.

**Treatment.**—The management consists in separating the opposed diseased surfaces by pledgets of cotton, gauze, or old linen, freely dusted with equal parts of starch and oxid of zinc. As soon as the material becomes moist a fresh dressing should be substituted.

When there is much associated involvement of the skin over the genitals, lower abdomen, thighs, and buttocks care must be exercised that the parts be kept free from decomposing urine.

Except in cases of the seborrheic type (p. 653) the management consists in neutralizing the urine by the use of bicarbonate of soda and in protecting the skin surface from irritating discharges by attention to the napkin. (p. 102). Dusting-powders are of very little use.

A most satisfactory procedure which has been followed with success even in the most unpromising cases is as follows: The mother or nurse is instructed to keep close watch of the napkin and change it as soon as it is soiled. She is further instructed to prepare pieces of gauze or old linen of such shape and size as to cover the denuded surfaces. On these slips of linen she is directed to spread a thick layer of zinc ointment (U. S. P.) to which 10 per cent. white wax has been added. This dressing is kept applied to the parts and is to be changed several times daily. If the ointment is simply spread over the skin, it will soon be absorbed by the napkin and be of no service.

Over the dressing the napkin is placed. The irritating urine is thus prevented by the ointment dressings from coming in contact with the skin. An additional quantity of absorbent cotton placed next to the genitals serves to absorb the urine as it is passed and thus prevents its general distribution over the parts. When the case is well advanced

toward recovery the maintenance of scrupulous cleanliness and the application of a dusting-powder composed of equal parts of powdered starch and oxid of zinc will be sufficient.

#### DERMATITIS IN OLDER CHILDREN

We have been considering dermatitis in children under two years of age. From the eighteenth month to the second year certain developmental changes take place in the child which render him much less susceptible to the toxic agents capable of producing the eczema. The ratio of cases seen after the second year to those under one year of age is about one to ten.

**Etiology.**—Gouty antecedents have been the rule. In older children as well as in the young dermatitis is of metabolic and gastro-intestinal origin as well as the result of protein sensitization. We find that in the causation of the skin condition certain substances play an important part, particularly milk-fats and sugars. Certain fruit acids and meat extractives have also proved operative in an etiologic way. Thus grape-fruit, orange juice, strawberries, tomatoes and beef juice have all been proved the immediate cause in a sufficient number of cases to establish the mode of origin beyond the slightest doubt.

Protein sensitization as a factor must be considered, although less prominently a cause than in the cases of young infants. An immunity to the offending protein is established with age. The cases of dermatitis that persist through infancy into childhood are usually of the so-called "lithemic class," with a defective fat and carbohydrate capacity or a tendency to seborrheic dermatitis.

**Symptoms.**—The cases of acute facial dermatitis are comparatively rare except in younger children. The tendency to development of pustules and furuncles is also much less in children over two years of age. Weeping and desquamating surfaces, however, are common, and squamous patches and fairly extensive infiltrated areas are frequently found on different portions of the body. Perhaps the most frequent manifestation at this age is what is referred to by various writers as "neurotic" or "reflex" "eczema." The predominating lesions in this form are papules which may exist in great number, especially over the extensor surfaces of the arms and legs. Often the individual papule is tipped by a black speck which represents dried blood and dirt resulting from scratching. In cases that have existed for some months there is a general thickening and hardening (infiltration) of the affected skin, with surrounding spots of inflammation, which are due to secondary infection, usually with staphylococcus. Dermatologists are now treating such cases with vaccines and local applications containing sulphur or salicylic acid.

By reason of the wide variety of its forms the inflammation may involve any portion of the skin. The skin about the umbilicus is one of the sites occasionally selected by the disease in older children. In some the only manifestation may be a superficial, slightly desquamating dermatitis at the angle of the mouth.

In the cases of seborrheic dermatitis the scalp will often show much dandruff and the entire skin surface in extreme instances will be dry and "branny," or dry and glistening.

*Illustrative Cases.*—A most troublesome case was that of a girl four years of age who presented a round, red, desquamating area on the right cheek,  $\frac{1}{2}$  inch in diameter. In the case of a boy four years old an acute weeping dermatitis had covered both buttocks.

A girl of five had suffered at intervals for eighteen months with an eczema between the fingers of the right hand.

A most interesting girl patient of eight years, after partaking of sugar in any form and in the smallest amount, beef juice, or any acid fruit juice, would develop an acute dermatitis of the face requiring two weeks for recovery. The mother, who is very intelligent, had discontinued milk before the case came under the writer's observation because of attacks of cyclic vomiting from which the child suffered, and which the mother stated were worse when milk was taken. Milk also produced hives and "poisoned" the child, so that the mother begged him not to give the patient milk. We found that the child could take fat-free milk. In this case there was a marked history of gout on both sides of the family. The maternal grandmother required crutches, the mother had cyclic vomiting as a child and sick headaches as an adult, and "had been treated for uric acid all her life," and the father stated that he was scarcely ever free from pain in his joints or muscles.

Another girl four years old, of decidedly gouty ancestry, suffered intensely during infancy from dermatitis, which was with difficulty kept under control. When two years old she developed recurrent bronchitis with asthma of a most severe type, and she has had several attacks of spasmodic croup. Milk-fat, sugar, fruit juice, or beef juice in the case of this child produced an intense inflammatory skin reaction.

These patients all recovered under dietetic measures alone.

**Prognosis.**—The prognosis is good, and the results are usually quite prompt following the right line of management. Relapses are not uncommon, however, because the treatment is so largely dietetic, and the best of people, when well, forget dietetic regulations more readily than anything else.

**Treatment.**—The successful management of dermatitis not due to local irritants depends upon the ability to discover the disturbing food factors and to eliminate these, or to render them inoperative through the application of heat. Little actual success has followed attempts to immunize against such proteins. A full physical examination should always be made and the condition of the blood and urine ascertained. The child is then given a régime of living suited to his condition. A diet schedule is furnished, the hours for rest and sleep and play are indicated, and if there is defective appetite or anemia, suitable added treatment is prescribed. One full bowel movement a day is required. It has been a matter of no little surprise for observers to find the eczema gradually disappearing as a result of improvement in the child's general condition. Through the correction of digestive disorders and the establishment of right living we have repeatedly seen cases of persistent dermatitis clear up entirely without other treatment.

In a general way the suggestions laid down for the management of subnormal children (p. 140) may apply. In the diet we allow little or no sugar. Milk, if used, is always skimmed and boiled for an hour or more. Butter, strawberries, tomatoes, and acid fruits are not to be allowed. The use of green vegetables is to be encouraged for the reason that they possess distinct therapeutic value. An absolute salt-free diet is not insisted upon, but only sufficient salt is used to make the food barely palatable.

Contrary to the established belief, we find arsenic of very little direct value, although in improving the general physical state of the patient it may be of service. Rhubarb, soda, and cascara appear to be of much greater value.

*Local Treatment.*—For the acute cases, in which there are much inflammation and itching, a combination of zinc oxid ointment, U. S. P., and menthol may be employed:

R. Mentholis.....	gr. x
Ungt. zinci oxid.....	3j

After the acute dermatitis has somewhat subsided the following ointment may be used with advantage:

R. Acidi salicylici.....	gr. x
Ungt. picis, U. S. P.....	3ss
Ungt. aquæ rosæ.....	q. s. ad. 3ij

This ointment should be used twice daily, the strength of the tar and the salicylic acid being increased if necessary as the case progresses. It is always well to begin with an application of a reduced strength and to increase the strength later as the case may require.

The ointment should be bound to the parts so as to completely cover the surfaces, thereby insuring the full benefit of the treatment and at the same time protecting the skin from further irritation by scratching. The case may respond very promptly, or it may be most obstinate and require several weeks of both dietetic and local treatment.

A most important feature of the management consists in protecting the involved parts, wherever located, from irritation by scratching and rubbing. This end is best accomplished by bandaging on the ointment applications. Such procedure not only prevents the scratching, but insures contact of the ointment with the affected areas.

*Bathing.*—When the skin is acutely involved water should not be allowed to come in contact with it. Sterilized olive oil should be used for cleansing purposes. On uninvolved portions of the body, and in chronic, inactive cases, the soda or bran bath (p. 844) may be used.

#### DERMATITIS DUE TO SEBORRHEA

Seborrhea is usually classified as an eczema. It is due to excessive secretion and activity of the sebaceous glands, and is regarded by some observers simply as a derangement of function. By others it is believed to be due to a specific infection.

This form of dermatitis may involve every part of the skin except the palms of the hands and soles of the feet. The flexures of the arms and legs and the contact skin surfaces in the groin and folds of the neck in fat children are particularly apt to be involved. How often one sees the picture of seborrhea capitis, scaling wet cheeks, and moist inflamed skin surfaces together with an intertrigo of the buttocks! Intertrigo is most common in those infants who have evident seborrhea elsewhere. The appearance of the involved area is fairly characteristic. It may be weeping, or dry and glistening, presenting the characteristics of a so-called erythema; or it may exhibit tendency to dryness and desquamation of very fine scales. Older children show what appears to be a diffuse evenly distributed dry exudate. In such cases there is almost invariably an associated extensive seborrhea of the scalp. This dry form, so-called *seborrhea sicca*, will usually be found after the first year. The picture of

the local lesion may be changed by local treatment, irritation through scratching or by the formation of cracks and fissures in the skin. Long-standing cases are very apt to be associated with gross lesions due to trauma. When we fully understand seborrheic dermatitis the problem of etiology and treatment of a considerable proportion of the cases of dermatitis in infants will have been solved. There is no doubt that this type of dermatitis is associated with that occasioned by faulty metabolism and protein sensitivity.

**Seborrhea Capitis (Milk Crust).**—The form in which the condition is most frequently seen in children develops on the head, producing thick, dirty, yellow crusts, commonly known as "milk crust." The exudation consists of sebum, dirt, and desquamated epithelium. In mild cases the crusts may be isolated or combined in one large patch with several surrounding smaller masses. In other cases the exudation is thick and uniform, and covers the vertex of the head like a mask.

**Treatment.**—The first step is to remove the crusts. The hair should be cut very short. If only a few areas are involved, anointing the parts with vaselin several times daily will soften the exudate, so that it may be removed. If the crust is thick and extensive, it should be softened with sterilized olive oil, applied on gauze or old linen which is well saturated with the oil, and held in place by a cap of cheese-cloth. If the dressing is applied at bedtime the crusts may often be removed the following morning. In cases in which the exudation has existed for a long time and is very hard, frequent fresh applications of the oil for two or three days may be required to soften the crusts sufficiently for their removal without injury to the skin. When thoroughly softened, they should be washed off with Castile soap and warm water. The underlying skin will then usually be found to be reddish and slightly inflamed. To this should be applied an ointment of resorcin and vaselin, 5 to 10 grains to the ounce. The ointment should be spread on linen or lint and applied to the parts with the aid of the gauze cap. In all except the most aggravated cases this treatment, used only at night, will be sufficient. In the severe cases a few additional applications of the ointment during the day will usually be effective.

A few days' treatment will often relieve the worst cases of seborrhœa capitis after the scalp has been freed from crusts. We have yet to see a case which will not respond when this treatment is properly carried out. It is to be remembered, however, that there is a tendency for the exudation to return. Mothers and nurses should be instructed to keep the ointment in the nursery for use upon the first appearance of the exudation. In children seborrheic dermatitis, according to our observation, is comparatively unusual in other portions of the body, although by extension of the seborrhea of the scalp, the forehead and face may be involved. In these situations, also, resorcin is useful, but must be used in much weaker strength, ranging from 0.5 to 1 per cent. If the trunk and limbs are involved the inflammation usually is very acute. In such cases it is best to use a very simple application, such as sterile olive oil or cold cream.

**Seborrhea Intertrigo.**—At rare intervals cases of intertrigo are encountered upon which no impression whatever is made by the methods

of treatment suggested on p. 650. Several years ago Dr. George T. Elliott, of New York, called attention to the fact that these cases were of seborrheic origin, and that a change from the ordinary treatment to that ordinarily used for seborrheic dermatitis would prove his contention. In the cases in question, and in those that we have since seen, the point made by him has been confirmed by the treatment. Cases of seborrhœa intertrigo are generally associated with seborrhea elsewhere, usually upon the head, and show erythema, a tendency to dryness of the skin, and desquamation.

The *treatment* in this form of intertrigo consists in enforcing cleanliness and a proper diet, as mentioned under Intertrigo, p. 650. In addition to the usual ingredients, from 0.5 to 1 per cent. of resorcin should be added to the zinc-oxid ointment which is used as a dressing. Euresol is here used with benefit in strength of 1 to 2 per cent. in unguentum aquæ rosæ. Involvement of the buttocks by this form of dermatitis results in most pronounced and obstinate cases. Here also applications, such as powders and ointments, should be of a soothing and protective nature. Instead of heavy, thick napkins cheese-cloth which has been boiled should be used, and after one using should be destroyed. Ung. zinci oxidi, U. S. P., to which 10 per cent. white wax has been added, may be spread on strips of old linen and placed over the parts, after cleansing with olive oil every time the napkin is changed. Of course soiled napkins should be changed at once. (See the Ammoniacal Diaper, p. 102.) Removal of the napkins and exposing the parts to the air for a considerable length of time is of much service in severe cases. Obviously little is to be expected from local application of drugs.

Seborrheic dermatitis, although not as difficult of management as the other forms of dermatitis in children, nevertheless shows a great tendency to recur, particularly in subjects of low vitality.

## PSORIASIS

Psoriasis is an unusual disease in children, that is, unusual to pediatricians and practitioners. Bulkley has seen the disease in a baby four months old. Dermatologists are agreed that from 10 to 15 per cent. of the cases that come under observation are under ten years of age. The disease is essentially chronic, occurring every winter, and often disappearing with the advent of warm weather.

The *lesions* of psoriasis possess features which render the diagnosis of little difficulty. The eruption first appears as brown flat papules with a tendency to desquamation. When the disease comes under observation there is usually a series of areas of the papules which have coalesced and formed plaques which are covered with white or grayish scales. When the scales are forcibly removed small bleeding points may be seen. The lesions are very variable in number, size, and location. In several patients they were situated on the forehead at the margin of the hair. Here thick infiltrated, desquamating crusts may form.

The site of the eruption is usually on the extensor surfaces, often about the knees and elbows. There may be but two or three small areas, or large portions of the skin surface may be involved. The nails par-

ticularly, and other portions of the hands and the plantar aspect of the skin of the feet are rarely affected. Staining of the skin at the site of the eruption remains more or less persistent. Symptoms not directly referable to the lesion are of little moment. There is usually some itching, but rarely is it severe.

**Etiology.**—The cause of psoriasis is not known. It is generally believed to be due to some constitutional error—a break in metabolism.

**Treatment** has been very unsatisfactory. The case may be relieved by an exclusive vegetable diet, which means an absence of meat, fish, poultry, and eggs. Bulkley has affirmed that cases may be cured and remain well when managed in this way.

Arsenic in the form of Fowler's solution is generally administered in the treatment of this disease. Autoserum therapy and foreign protein injections have both been advocated.

Of the various local applications those containing chrysarobin, salicylic acid, tar, and ammoniated mercury have been of greatest value. To be effective the chrysarobin ointment must be rubbed into the patches sufficiently to excite some inflammatory reaction. This treatment is to be suspended at intervals, during which a milder application, such as rose-water ointment, may be substituted.

### BED-SORES (DECUBITUS)

During any illness productive of greatly disturbed nutrition or emaciation, such as cerebrospinal meningitis, typhoid fever, and empyema, constant pressure on the prominent bony parts interferes sufficiently

with the circulation to cause destruction of the integument. The most frequent sites for decubitus in children are the sacrum, the heels, and the back of the head.

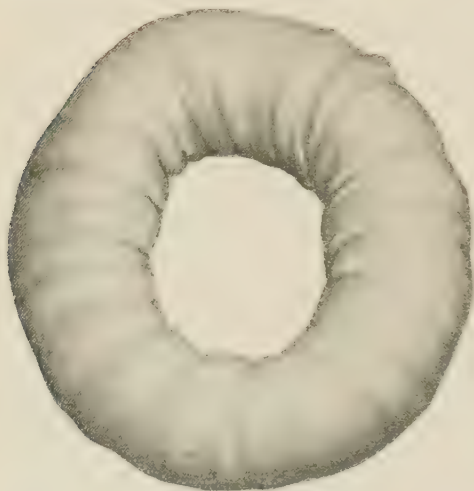


Fig. 115.—Head-rest to prevent bed-sores.

The condition is best prevented by special care in maintaining cleanliness, by keeping the bed-linen smooth, frequently changing the position of the patient, and by the free application of any simple powder, such as equal parts of powdered zinc oxid and starch.

**Treatment.**—The parts as they become sensitive and show redness should be bathed several times a day with alcohol. If this does not relieve

the condition, the areas should be covered with diachylon plaster so as to insure complete protection. The air-cushion or the water-bed may be necessary in any prolonged illness.

When the back of the head is involved the scalp should be shaved

and the head allowed to lie in a home-made head-rest (Fig. 115) which is constructed as follows:

A piece of fairly stiff wrapping paper 4 inches wide is twisted into a rope, of which a circle 4 to 5 inches in diameter is made by bringing the ends together. The paper is then wrapped thickly with absorbent cotton, which is, in turn, wrapped with a 2-inch roller bandage.

### NEVUS (BIRTH-MARK)

A nevus is a congenital new formation in the skin. The growth may be pigmentary or vascular.

**Etiology.**—No one of the various theories which have been advanced to account for the existence of nevi is well established. The frequent occurrence of vascular nevi in such regions as the back of the head and nape of the neck has given rise to the belief that these marks may be produced by intra-uterine pressure. Virchow emphasized the predilection of the growths for the embryonic fissures of the skin, where slight irritation would be capable of exciting anomalous vascular development. Females are more frequently affected than males.

**Characteristics.**—The pigmentary moles comprise *naevus pilus*, a smooth, pigmented spot; *naevus pilosus*, the hairy mole; *naevus verrucosus*, a raised warty growth; *naevus lipomatodes*, which contains hypertrophied fat tissue; and *naevus linearis*, which is usually unilateral, and frequently follows the distribution of cutaneous nerves. The moles may be brown or black, single or multiple, and are most common on the face, neck, and back.

Vascular nevi range in character from small capillary angiomas to large, raised, pulsating tumors. One of the most disfiguring marks is the *naevus flammeus*, or "port-wine stain." This is a bright red or purple spot, of irregular outline and more or less uneven surface, commonly found on the face, and covering an area which may be as large as the palm. The true vascular nevi all become pale under pressure, and, conversely, show the deepest color when the local blood-pressure is increased by such acts as crying or coughing.

**Prognosis.**—Pigmentary moles rarely disappear spontaneously. The simpler forms of angioma may, however, occasionally undergo atrophy, or, on the contrary, increase in size over a limited period.

**Treatment.**—Satisfactory results in treatment call for the exercise of considerable patience and skill. Many of the smaller capillary nevi may be made to disappear under the pressure produced by repeated applications of collodion. In more pronounced cases "stippling" with nitric acid, electrolysis by multiple punctures, and exposure to the x-ray or radium are methods of value. Jackson has emphasized particularly the value of freezing by liquid air or carbon dioxid snow. In suitable cases excision may be performed.

Special mention should be made of the tragic results which have occasionally followed mechanical interference with certain forms of mole. Although it is possible that metastasis with general sarcomatosis is a phenomenon confined to adults, no one who has witnessed such an occurrence will advocate conservative surgery in the removal of pigmental growths. Unless excision can be thorough and complete, it should not be attempted.

## VIII. DISEASES OF THE EAR

### EARACHE

IN every case of earache in an infant or young child the ear-drum should be examined. It may show intense congestion and bulging, requiring immediate incision, or only slight congestion about the periphery of the drum and at the tip of the malleus. When the latter condition exists there are various means of relieving the pain, the most effectual probably being instillation into the ear of equal parts of a warm 4 per cent. solution of cocain and camphor-water, 5 drops of which are dropped into the ear, and repeated every half-hour if necessary, after which dry heat may be applied by the use of a hot-water bottle or a salt bag. Severe attacks of earache are frequently relieved by means of a hot-water douche with 1 pint of water at 110° F. When the pain is not promptly relieved, the ear should be carefully watched, particularly if there is recurrent shooting pain, a throbbing sensation, or a feeling of fulness in the ear.

In young children a rise in temperature associated with earache is often indicative of an acute infectious process in the middle ear, and, in addition to the treatment suggested, the ear should be frequently examined, in order, if necessary, to insure early incision of the drum membrane.

### DEAFNESS

Hearing is probably established in the newborn during the first two or three days of life. During the early months of life the hearing is very acute. Acquired deafness is not at all unusual, however, even in comparatively young children. Among its most frequent causes is an extension of an inflammation from the throat to the tubal mucous membrane. In diphtheria, in the exanthemata, in grip, in tonsillitis, and in many other ailments of early life there is an associated inflammation of the nasopharyngeal structures. Unless infection of the middle ear occurs, deafness is usually of a very temporary nature. Persistent deafness may be the result of enlarged tonsils, adenoids, or organized changes in the canal or in the middle ear. Among the most frequent causes of persistent deafness in children are adenoids, scarlet fever, and cerebrospinal meningitis. Congenital syphilis is an infrequent cause of deafness. Response to treatment in this type is very satisfactory. Deafness at rare intervals follows an attack of mumps and is due to an involvement of the labyrinth. This condition calls for expert otologic treatment.

Deaf children whose condition is not recognized are often accused of inattention and punished when they are slow in responding when spoken to. They make slow progress in school and are considered stupid. Many such children suffer from defective hearing of a pronounced type due often to enlarged tonsils and adenoids.

Every child who presents indications of defective hearing should at once be examined by a competent aurist.

## ACUTE OTITIS

Among the ailments of children few diseases are more frequently encountered than catarrhal or purulent otitis media. It occurs with great frequency in the hospital athreptic and in the institution infant. No age is exempt. Otitis is not infrequent in infants a few weeks of age. In well-nourished, vigorous older children it is, with but few exceptions, a secondary infection. In poorly nourished athreptic infants it may occur without other evidence of illness. Repeatedly otitis of a low grade has been discovered in athreptics who lacked the usual signs of fever, discharge, and bulging of the drum. In fact, in a considerable number of cases the otitis was first discovered at autopsy.

**Types.**—It is customary to divide the cases into two primary types: simple catarrhal and purulent. Such a grouping is hardly necessary, as most cases of the purulent type if seen sufficiently early present what are described as catarrhal symptoms. If the infection is not severe it subsides or responds to treatment. On the other hand, cases are seen in which the ears have been frequently examined and in which the inflammation has been unquestionably purulent from the onset.

**Etiology.**—Otitis is caused by the invasion of bacteria into the middle ear.

In the atrophic young infant the low systemic resistance and the patulous eustachian tube account for the ease with which the infection reaches the middle ear and becomes operative. In older children adenoids and enlarged tonsils comprise the chief predisposing etiologic factors. Influenza, scarlet fever, measles, and diphtheria are the diseases most frequently accountable for otitis. It may follow any infection of the nose or throat, often complicating rhinitis and tonsillitis. If a considerable growth of adenoids exists in the vault of a throat affected by any one of the above diseases, the chances are more than even that suppurative otitis will develop.

Among a series of 72 private cases which were reported several years ago, 3 were apparently primary, in that the condition did not follow and was not connected with any previous abnormal state. One case followed German measles; 4, scarlet fever; 7, measles; and 58, influenza or catarrhal colds.

**Bacteriology.**—In a series of 47 cases in which bacteriologic examinations were made the results were as follows:

Streptococci in pure culture.....	13
Staphylococci.....	11
Streptococci, staphylococci, and pneumococci.....	12
Streptococci, staphylococci, and pneumococci.....	6
Staphylococci, pneumococci, and colon bacilli.....	1
Streptococci and staphylococci.....	2
Pneumococci.....	2

*Streptococcus hemolyticus* and *Streptococcus mucosus capsulatus* supply the most dangerous forms of infection, and in these types not only are all the symptoms more severe, but there is much greater danger of mastoid involvement and secondary sinus thrombosis.

**Symptoms.**—Among all the diseases of children none is probably so frequently overlooked as otitis. This is due to the fact that the prac-

itioner invariably looks for pain as a symptom of the disease, and this has been the teaching of the books. In a search of many works on otology it was ascertained that the symptoms as laid down comprise almost exclusively the evidences of pain—*earache*—the pain being complained of by older children, or manifested in the very young by vigorous crying, by tossing the head from side to side, by head-rolling, ear-tugging, crying out in sleep, disinclination to rest the head on the affected side, or pain upon manipulation of the ear. In short, we have been taught that there is invariably some manifestation of pain referable to the ear or the adjacent structures in all cases of acute otitis in infants and young children. Such symptoms exist in a moderate number of cases.

The most interesting feature, however, in this series of 72 cases was the absence of pain or localized tenderness on manipulation in 50 of the cases, or 69 per cent. Among those included in the pain group, 22 in number, there were some cases which perhaps should not be so included, inasmuch as there were no signs of pain, as we generally expect to find it. The group included those who were very restless, who slept poorly, and who showed evidence of the relief which followed incision of the drum membrane, so that it was fair to assume that the source of the previous discomfort was the ear. Had we depended upon the signs of pain or local tenderness, in 50 of the cases a diagnosis of otitis at the time would have been impossible. Six were seen in consultation because of the unexplained continued fever. Nine had been treated by other physicians who had failed to discover the cause of the continued fever. In none of these had ear involvement been suspected, because of the absence of pain and localized signs.

*Fever.*—Among the 72 private cases already mentioned in well-nourished children one symptom was present in all—fever. There was nothing particularly characteristic in the temperature range. In some there were the morning drop and the evening rise. In others the temperature variations were inconstant. With but few exceptions the otitis developed during convalescence from an acute process localized elsewhere, the ear involvement being suspected because of a persistent elevation of the temperature for which no other cause could be discovered.

The fact that 58 of the cases, or 81.5 per cent., occurred with or followed non-specific inflammatory conditions of the upper respiratory tract, such as tonsillitis, grip, and catarrhal colds, emphasizes the necessity for frequent aural examinations during or following such disorders, particularly when there is an elevation of the temperature, which, in the absence of definite clinical signs, we are apt possibly to attribute to chronic grip, malaria, typhoid fever, or dentition.

*Course.*—In a small number of cases spontaneous perforation of the drum occurs. We have known the membrane to rupture in one hour from the onset of the ear symptoms, and have known it to remain intact with pus in the middle ear, to the best of our judgment, for ten weeks. In the average case, after a free opening of the drum, the discharge persists from ten to twenty days. In cases due to streptococcus infection the discharge is usually more prolonged.

*Prognosis.*—The prognosis is good if the drum is freely incised and kept open. A certain small percentage of cases which is difficult to de-

termine develop mastoid disease, and a still smaller number become complicated by sinus thrombosis and jugular bulb involvement. Much depends upon the nature of the infection. If the streptococcus is found in the discharge mastoiditis as a complication is not improbable.

The drum heals most readily. In numerous cases treated by free incision the drum has been found absolutely normal in appearance within three or four weeks after the discharge ceased.

**Diagnosis.**—Fever without apparent cause should always call for an examination of the ears. Earache is a symptom demanding like attention.

Otoscopic examination settles the diagnosis and is the means of confirming or refuting symptoms of unsolved fever or indefinite pain.

A culture should be made of the discharge from every ear opened.

**Complications.**—The most frequently encountered complication is mastoiditis caused by extension of the infective process to the mastoid cells. The mastoid antrum is separated from the middle ear by a very delicate membrane. In many cases of acute otitis, probably in all cases showing prolonged discharge, the antrum is involved. If immediately after mopping out the canal there is a free discharge into the canal, this affords proof that the antrum is involved, as the small middle ear could not form pus with such rapidity.

Prolapse of the posterior superior wall is another sign of mastoid involvement.

The continuation of fever in spite of free aural discharge is indicative of mastoid abscess.

If the mastoiditis exists, there may be swelling behind the ear or tenderness on firm pressure over the mastoid, particularly at the tip. Both of these symptoms—pain upon pressure and swelling—may fail us, and their absence is not to be considered in any way conclusive evidence against the presence of mastoid disease. There is no doubt that in many cases of prolonged aural discharge the antrum is diseased and supplies a large part of the pus, while the deeper cells in the bone escape infection.

There are cases in which the mastoid is primarily involved; others in which there is a primary infection which takes in both the mastoid and the middle ear at the same time. To have mastoid disease does not mean that the middle ear must be primarily involved.

**Treatment.**—A small percentage of the catarrhal cases in which there is congestion of the drum without bulging, will subside under irrigation at two-hour intervals with normal salt solution at 110° F. One pint should be used. A fountain-syringe placed at an elevation of 3 feet above the child's head affords the best means of irrigation.

Regardless of the age or condition, a bulging drum in the presence of fever calls for incision. No harm is done to the ear by the free incision properly made, while much harm as the result of chronic otitis media and mastoid disease may occur when the incision is delayed.

**Operative.**—Every practitioner who has children as his patients should be sufficiently familiar with the landmarks of the normal drum membrane at the various ages of early life to differentiate the normal from the abnormal. In the routine examination of the child, in all conditions associated with angina or fever, the ear should be included. In quite

young babies an otoscopic examination may show a dull, whitish appearing drum membrane which, on a superficial examination of the case, might be ignored. In all cases, particularly at this age, when the drum landmarks are indistinct, a cotton-pointed probe should be brushed over the surface, thus removing the epithelial scales which may have lodged there, with the result that perhaps a congested, bulging membrane may be revealed.

Conditions or appearances of the drum membrane which require incision are often difficult of recognition by those not skilled in otoscopy. When the drum is bulging, deeply congested in appearance, with landmarks indistinct, an incision is necessary, and should be made in the posterior quadrant, beginning low down and extending upward through Shrapnell's membrane. When also there is congestion of the drum membrane over the tubal entrance, and when the congestion extends toward the periphery, producing indistinct landmarks without bulging, incision is indicated.

*Postoperative.*—The after-treatment following incision ordinarily consists in syringing the ear at three-hour intervals with 8 ounces of a saturated solution of boric acid for three or four days, after which the syringing may usually be practised at intervals of from four to five hours until the drum closes. In very young infants if the boric acid causes a deposit in the canal, it is well to change to a sterile normal salt solution, using the same quantity of fluid.

In those cases in which only serum is present at the time of operation, closure within ten days may be expected; if, however, pus is present, from two to three weeks will be required. A sudden stopping of the discharge usually means that the opening in the drum is closed, either through plugging with thick pus or because of too early healing. In either event a re-establishment of the discharge by removing the obstruction or by reincision is essential. The chief factors in prolonging the discharge are adenoids and a lowered state of physical resistance.

After the syringing the ear should be carefully dried with absorbent cotton.

For purposes of syringing a 1-ounce hard-rubber ear syringe with soft-rubber tip answers best. If this is not obtainable, a douche-bag, at an elevation of not more than 3 feet above the patient's head, may be used. The douche-bag sometimes is desirable for those who are unskilled, or a soft-rubber bulb syringe of a capacity of 1 or 2 ounces may be used. The small double-current ear-irrigator may be used with advantage for the reason that it largely prevents wetting the patient. During treatment by any of these methods the child rests on his back with his hands pinned to his side by means of a large bath towel, while a pus basin is held under the ear to catch the flow. If the nurse can have an assistant, the upright position may be used.

*Delayed Resolution.*—In a certain number of cases resolution is delayed and the discharge continues. In such cases a decided aid is furnished by the use of stimulating and disinfectant instillations. After the last syringing for the day the canal should be dried by the use of a wick of absorbent cotton. Five drops of the following solution are then to be instilled into the ear:

R. Pulv. acidi borici.....	gr. xxv
Spts. vini rect.,	
Aquæ.....	āā ʒss

A 15 per cent. solution of argyrol may be used in a similar manner.

## CHRONIC SUPPURATIVE OTITIS

Not infrequently cases come under our care in which there is a purulent discharge from the ears, often most offensive, with a history that the discharge has followed measles, scarlet fever, or grip, and has continued for weeks or months. Examination may show a perforation of the upper portion of the drum, through which there is a free discharge, which, however, on account of the site of the perforation, is not sufficient to drain completely the middle-ear cavity. In other instances the examination may disclose an opening too small for effective drainage.

**Treatment.**—In either case incision should be made and free drainage established. The ear should then be syringed at least three times a day with a 1 : 10,000 bichlorid solution. The instillation of a solution of alcohol and boric acid (see p. 662) may also be used with decided advantage. In cases of chronic suppurative otitis it is well to examine for adenoids, as these growths in the nasopharyngeal vault help to keep up ear discharge indefinitely. The presence of dead bone and granulations is also to be considered in the chronic suppurative cases. When the presence of dead bone or granulations is established, the condition calls for radical procedure by a skilled otologist in order to avoid mastoid and intracranial complications. In fact, cases of this nature should be treated only by an otologist.

## MASTOIDITIS

Because of the ease with which pus may enter the mastoid antrum the complication of mastoiditis is of frequent occurrence in acute aural diseases. Streptococcal infection of the middle ear predisposes to mastoid involvement. Delay in incising the drum and establishing free drainage in acute otitis is also a factor in not a few cases. Finally, as an underlying cause of mastoiditis should be mentioned the child's lack of general resistance to bacterial infections.

It is not to be forgotten that mastoid disease may be primary or occur synchronously with the development of otitis media.

**Symptoms.**—Mastoid disease may be looked for in all cases in which an elevation of the temperature continues in spite of free discharge through a well-opened drum. Tenderness on pressure is a valuable sign, but its absence does not preclude mastoiditis.

Prolapse of the posterior superior wall and the rapid appearance of pus in the canal after thorough cleaning are to be looked upon as most important signs.

When there is tumefaction and swelling of the soft parts behind the ear (perimastoiditis), the mastoid cells and antrum will almost invariably be found involved. In about 10 per cent. of the cases both mastoids will be involved.

**Complications.**—The complications are sinus thrombosis, jugular involvement, facial paralysis, septic meningitis, and pyemia. We have seen all these most serious complications in not a few cases, and have cause to regard the presence of pus in the mastoid cells or even in the middle ear in children as a matter of serious import.

**Treatment.**—Operation, and that early, is the only treatment for the

condition. Children have unquestionably recovered from mastoid disease without operation, but expectant procedures are fraught with great danger and should not be countenanced if the child is in condition to admit of operation.

### SINUS THROMBOSIS

In a small percentage of cases of mastoiditis there is extension of the infection to the lateral sinus.

**Symptoms.**—Sinus involvement will usually be indicated by rapid and wide variations in the temperature. The rise is very sudden, and may reach 106° F. The fall may be correspondingly rapid, and a peculiarity of the temperature phenomena in sinus disease is the extent of the fall.

The writer has seen a rise of 10 degrees in two hours, and has repeatedly known the fever to drop to 96° F.

A confusing and misleading circumstance in these cases may be the absence of signs of great prostration. When the temperature is high the child appears very ill; when the fever subsides the patient brightens, perhaps plays, and is interested in his surroundings. It is difficult to reconcile the patient's demeanor with so grave a disease. The misleading behavior, in our observation, has been the occasion of delaying operative measures until such means proved of no avail.

Leukocytosis and a high polynuclear count are usually present. In one case, however, the polynucleosis was not above 60 per cent.

Bacteremia is usually present. Its absence, however, does not preclude sinus disease. Metastases of bacterial emboli, with the development of septic arthritis, endocarditis, pneumonia, and meningitis, are to be expected when the infection is overwhelming.

**Treatment.**—The treatment is the radical operation, with resection, if necessary, of the jugular vein. Transfusion is a supplementary procedure of great value.

## XIX. THE TRANSMISSIBLE DISEASES

In this group of diseases for purposes of convenience are not included a number of affections elsewhere discussed, the characteristic tendency of each of which is to single out one organ or structural group in the body for attack.

The present discussion relates to a less selective group to which the term "transmissible" is probably more patently applicable. Year by year, however, such designations become less definite and such terms as "infectious" and "contagious" have a wider connotation.

*Diseases Which May Be Transmitted Through Contact.*—Syphilis, diphtheria, gonorrhea, stomatitis, tuberculosis, pneumonia, scarlet fever, measles, German measles, mumps, smallpox, chickenpox, pertussis, poliomyelitis, meningitis, acute cerebrospinal meningitis, plague, typhus, influenza, encephalitis.

*Diseases Which May Be Transmitted Through an Intermediary.*—Gonorrhea, typhoid fever, malaria, yellow fever, tuberculosis, cholera, plague, stomatitis, scarlet fever, diphtheria, measles, chickenpox, pertussis, syphilis, typhus, and poliomyelitis.

It will be observed that some of the foregoing diseases are transmissible in more than one way.

Syphilis, in addition to being transmissible through association, is transmissible by inheritance.

Gonorrhea is transmissible through association and through intermediary objects. That the latter mode of conveyance is common is absolutely proved by the spread of the disease in institutions and hospitals, through the use of the thermometer or at the hands of attendants.

Among the diseases grouped as transmissible through association, in which such transmission is eminently a feature of the disease, are those that usually have been designated as *contagious*, *e. g.*, scarlet fever, diphtheria, measles, German measles, mumps, smallpox, chickenpox, pertussis and poliomyelitis.

Among the diseases transmissible by intermediary means, gonorrhea has been referred to.

Typhoid fever is usually water borne or food borne by flies. Malaria and yellow fever are transmitted by the mosquito.

Cholera is usually a water-borne disease.

Plague may be transmitted through any intermediary which has been in contact with the infected subject.

Stomatitis, a comparatively insignificant disease, may be transmitted through nipples, pacifiers, or toys that have been in the mouth of the patient.

There is quite an unanimity of opinion that scarlet fever, diphtheria, measles, chickenpox, mumps, and smallpox may be transmitted from the diseased to the unprotected individual through the agency of an intermediary person or object. Our own observation corroborates this view. At the same time we are sure that such transmission is less frequent than is generally supposed.

The usual means is through association with an individual who has the disease, perhaps in so mild a manner that it has not been recognized. This is particularly the case with diphtheria, scarlet fever, and poliomyelitis.

These diseases, viz., scarlet fever, diphtheria, measles, chicken-pox, pertussis, German measles, poliomyelitis, and mumps, have another feature in common. They may be extremely severe, or so mild that the case is not recognized, and the patient associates as usual with his fellows. It is to these mild cases that the spread of the disease is ordinarily due rather than to a transference of the contagium through unusual channels.

It has been estimated that 1 per cent. of children in cities have viable diphtheria bacilli in their throats.

Scarlet fever, because of the possible variation of its course and the indefinite rash, is overlooked more frequently than any other of the diseases of this class. It is not at all unusual for school inspectors to find children with active scarlet fever desquamation in attendance at schools.

Abortive non-paralytic cases of poliomyelitis are unquestionably a chief agency in the transmission of this disease.

The writer has seen a case of chickenpox in which there were but five vesicles without other sign of illness, and patients with unquestionable pertussis who never whooped.

#### CARE TO BE EXERCISED BY THE PHYSICIAN IN VISITING INFECTIOUS AND CONTAGIOUS DISEASES

Physicians in attendance upon contagious diseases, particularly diphtheria and scarlet fever, should exercise reasonable care in their association with other patients. The coat should be removed and shirt-sleeves turned up to the elbows. A gown, or a sheet suitably adjusted with safety-pins, should protect the clothing.

#### SMALLPOX (VARIOLA)

**History.**—Numerous descriptions left by ancient authorities afford evidence that smallpox has existed from the earliest times, in fact long before the Christian era. France and Italy were ravaged by this form of pestilence in the sixth century and England is supposed to have been invaded by the disease as long as one thousand years ago. Prior to the discovery by Jenner of vaccination in 1798 smallpox annually caused thousands of deaths in England, while in less advanced countries the mortality was even greater.

For over one hundred years before Jenner's discovery inoculations had been practised, first in Turkey and later in England and America. The disease, when "engrafted," was uniformly observed to be much milder than when contracted in the ordinary manner. When thus inoculated from patient to patient, however, the affection maintained its contagious character, and for obvious reasons the practice had much to condemn its employment. To Sydenham in the seventeenth century was due much of the better understanding of the disease.

Not until the proof by Jenner that those individuals previously vaccinated with cowpox virus were immune to smallpox was the way opened

for general and safe immunization. As an example of effective artificial immunization against disease this form of vaccination, even since the time of Pasteur, has remained pre-eminent.

**Etiology.**—Smallpox respects no race, no age, and no sex; even infants seem to possess no natural immunity. The disease is most prevalent in winter.

The exact nature of the specific cause remains in doubt, although the work of numerous investigators, including Guarnieri, Councilman, and Prowazek, indicates that the causative organism belongs to the protozoa. Contagion is transmitted by direct contact with skin lesions and body excretions and also through clothing, the virus being extremely viable and persistent. Immunity after one attack is the rule.

**Pathology.**—The most significant changes induced are exhibited by the skin lesions. Councilman has demonstrated that even at the outset these lesions, in spite of their macroscopic papular appearance, are actually vesicular, while the organisms causing the disease are apparently brought to the skin lesions by the blood.

In general, the progressive changes exhibited by the cutaneous lesions are indicated by the symptomatology presently to be discussed. On mucous surfaces, ulcerations and erosions take the place of the lesions produced in the skin.

Fatty degeneration and focal necrotic areas are found in the viscera. Necrotic changes in the bone-marrow have also been described. Both bone-marrow and blood show a noteworthy diminution in polynuclear cells.

Glomerulonephritis, otitis, pneumonia, and corneal ulcerations are among the pathologic conditions which may complicate ordinary smallpox.

**Incubation Period.**—This ranges typically from ten to twelve days, rarely being prolonged to sixteen to twenty days, particularly in the mild forms of the disease.

**Symptomatology.**—In the child the course of the disease, which is practically the same as in the adult, progresses through fairly definite stages.

**Invasion.**—Prodromal symptoms are usually not significant, although chilliness, headache, sore throat, or lassitude may be noted. The onset is as a rule sudden and accompanied by a chill with headache, backache, and a rapidly rising temperature of 103° F. or higher. Not infrequently the fever in children ranges as high as 106° F. The pulse is full and is increased in rapidity, proportionally to the temperature elevation. The tongue becomes heavily coated and the breath foul. Vomiting may be the first symptom and at times is persistent. Convulsions, delirium, and in children coma are not infrequent. Vertigo is occasionally a feature.

Before the completion of the initial stage a prodromal rash may appear. This may be scarlatinaform or more often morbilliform and at times is definitely petechial or hemorrhagic.

**The Eruptive Stage.**—The initial stage is superseded with regularity on the third day by a period in which the characteristic phenomenon is the development of red macules in rapidly increasing numbers, which quickly become elevated and papular, "shotty" on palpation. By the

fifth day of the disease the lesions become vesicular and even before this they may coalesce. The typical vesicle shows a central umbilication and is multilocular.

The eruption is most profuse on the portions of the body showing the greatest skin congestion, particularly the face.

By the sixth day the vesicles undergo suppuration and show a deeper areola so that the parts most affected become actually edematous, the eyelids at times becoming closed. The maturation of the eruption on the face, in keeping with the first appearance of the rash at this site, advances before the development of pustulation on other portions of the body. Retrogression of the pustules becomes apparent about the eighth day.

In the mouth, because of the delicate character of the epithelium, the lesions take the form of erosions or ulcerations. The tongue may be very sore, and the throat so sore as to make swallowing very difficult.

During the interval between the onset of the eruptive stage and the development of suppuration abatement in the fever and accompanying constitutional symptoms is the rule, but the fever recurs with the pustular stage at about the fifth or sixth day of the illness, usually, however, in less degree than during the stage of invasion of disease.

The blood shows leukocytosis with a relatively high percentage of lymphocytes.

*Involution.*—Subsidence of tumefaction marks the beginning of retrogression of the eruption at the end of the pustular stage, the face first showing the improvement. Desiccation and crust formation usually begins about the tenth to the twelfth day of the eruption. Three or four weeks may elapse before desquamation is complete. During the drying stage, itching is a most annoying symptom.

**Varieties of Smallpox.**—*Confluent smallpox*, as its name implies, involves almost the entire body surface. The mortality is high.

*Petechial* and *purpuric smallpox* are malignant hemorrhagic forms of the disease, variola purpurica being most fatal. The pustular hemorrhagic form is an extreme type.

*Mild smallpox* is today the form most prevalent in the United States. Individuals affected by this type of the infection may not be confined to bed at any period throughout the entire course of the disease. Such cases are marked by a moderate intensity and show a rash which is easily mistaken for a chickenpox eruption.

**Differential Diagnosis.**—The initial symptoms of headache, generalized pain, chill, and fever, with perhaps vomiting, are at times mistaken as indicative of the onset of grip, pneumonia or meningitis, while the prodromal eruption may give rise to a wrong diagnosis of scarlet fever or measles.

The disease most frequently confused with variola is chickenpox. This is due to the prevalence of smallpox in a mild atypical form because of existing partial immunity in the patient, conferred by vaccination. This, although performed years before the time of the disease attack, may nevertheless afford considerable immunity.

In making the differentiation between variola and varicella the following points are to be kept in mind:

In smallpox the rash is particularly abundant on the face, back, and

limbs, whereas in chickenpox lesions are distributed variably with a tendency to avoid the limbs and appear on covered areas of the body. Furthermore, the vesicles in varicella are more superficial than in smallpox and are generally unilocular, are never umbilicated, and, unlike those of smallpox, tend to appear in successive crops. Owing to the prevalence of early vaccination variola is relatively rare in early childhood.

In doubtful cases the vaccination may be used as a test of great value, successful recent vaccination or successful vaccination after the third day of the eruption being almost positive evidence that the disease under observation is *not* smallpox.

**Complications and Sequelæ.**—Among the most important and frequent secondary affections are bronchitis and pneumonia. Edema of the glottis with ulcerative lesions in the throat has been observed. Otitis media, conjunctivitis, and even corneal ulceration are also seen as the outcome of smallpox, while adenitis, nephritis, and pericarditis may develop. Cellulitis, boils, abscesses, erysipelas, and even tetanus may result from secondary infection of the skin lesions.

**Prognosis.**—Among children smallpox unmodified by vaccination is particularly fatal. Woody<sup>1</sup> has emphasized this fact by recalling that in an epidemic in Montreal during 1884-86 over 85 per cent. of all fatalities were among children under ten years.

The hemorrhagic and confluent forms are extremely fatal and in general the prognosis is considered to be bad proportionately to the character and number of the skin lesions.

**Treatment.**—*Prophylaxis.*—Vaccination, preferably during early infancy, constitutes the only reliable form of prevention. Vaccination should be repeated every five to seven years, although following vaccination in infancy revaccination at puberty and again in the fourth decade has been proved effective in affording lasting protection in all but exceptional individuals.

*Isolation.*—This should be practised most conscientiously with regard to the prolonged segregation, not only of the patient, but of all recently unvaccinated contacts until two weeks at least have elapsed. Quarantine of the patient himself should be strictly maintained much longer until all crusts have been desquamated.

*General Therapy.*—After the stage of onset during which antipyretics and sedatives may be administered with advantage, as in the treatment of grip, hydrotherapy in the form of sponging, packs, and cool baths is of most value. After suppuration is established warm baths may be substituted.

Topical applications to the lesions comprise a long list in which tincture of iodine, as an agent of value in shortening suppuration and thus preventing scarring, holds a foremost place. Alcohol, 25 per cent., in boric acid solution, and bichlorid of mercury, 1 : 10,000 solution, have also proved of value. During the late stages various antiseptic ointments are of aid in facilitating desquamation and relieving itching.

Mouth-washes are indicated and their use should be supplemented by particular attention to local ulcerative conditions of the gums or tongue.

The *diet* during the acute stage should consist of fluids only. Later

<sup>1</sup> Tice, Practice of Medicine.

milk toast, ice-cream, stewed fruit, vegetable purées, and simple desserts may be added.

In general, the treatment is solely supportive and symptomatic. Nursing in smallpox, as in the conduct of typhoid fever, holds a place of peculiar pre-eminence.

During convalescence an out-of-door life and liberal feeding may be supplemented by the administration of appropriate tonics, as in the after-management of severe measles.

### CHICKENPOX (VARICELLA)

Chickenpox belongs to the transmissible diseases, and is usually transmitted by association contact, rarely through an intermediary. The contagium of varicella is present in the fluid contents of the eruptive vesicles, and also in the crusts resulting from the drying of the vesicular contents. Consequently the period of transmissible infection persists as long as any crusts remain on the skin. The specific etiologic factor in this disease is still unknown.

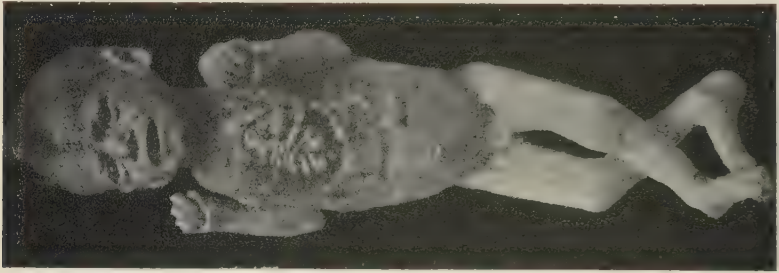


Fig. 116.—Deep ulceration in case of dermatitis gangrenosa infantum following chickenpox.

**Incubation.**—The period of incubation is rarely less than eighteen days nor longer than twenty-five days. In the majority of cases it has ranged between twenty and twenty-five days.

**Symptoms.**—Prodromal symptoms are rarely of sufficient severity to warrant complaint or give evidence of illness on the part of the child. In severe cases there may be slight temperature and muscle soreness.

The *temperature* rarely goes above 102° F., usually not over 100° F.

**The Rash.**—The eruption is usually the first important sign of the disease. The back and abdomen are the sites ordinarily involved early. The rash may appear on any portion of the body. It occurs abundantly on the scalp. Usually there are a few spots in the mouth.

Not infrequently from the onset the lesions are distinctly vesicular, without any associated skin inflammation, resembling drops of water that may have been sprinkled carelessly over the skin surface. More frequently the rash consists of macules, then papules, and later vesicles resting on well-defined red areolæ. At first the vesicles contain clear fluid and vary in size from mere points, scarcely discernible to the naked eye, to lesions  $\frac{1}{8}$  inch in diameter. In a few hours the serum becomes cloudy and purulent. In from twenty-four to seventy-two hours the

fluid is absorbed, leaving the erupted area slightly umbilicated, so that on further drying this forms a crust or scab. These crusts fall off in from one to three weeks, each leaving a distinctly reddish skin area, at the site of which there is sometimes a temporary scar. The rash varies greatly in its intensity. Most of the lesions do not go through the characteristic stage just mentioned, and many do not go beyond the papular stage. All stages of the eruption may be seen at one time in any well-marked case, for the reason that the rash appears in successive crops, of which there are usually three, although there may be more. The first crop may be in the scabbing stage when the third or a later crop appears. The amount of rash is extremely variable.

*Illustrative Cases.*—In 1 case there were but three vesicles.

In 3 others, all institution cases, so severe and extensive was the rash that it resulted in a gangrenous dermatitis consisting of clearly punched-out ulcers. The gangrenous area coalesced, with destruction of large areas of the skin surface. These 3 cases were all fatal.

**Duration.**—The duration of an attack, from the beginning of the period of eruption until the skin clears, is about three weeks. In mild cases the skin may become clear in two weeks.

**Quarantine.**—The child should be kept in quarantine and not allowed to come in contact with unprotected children until three weeks have elapsed, or until the skin is free from crusts.

**Complications.**—Erysipelas was a complication in 2 cases; gangrenous dermatitis in 3. Nephritis, although rare, may develop. One of the most severe cases of acute glomerular nephritis treated in a long period occurred as a sequel of chickenpox. Furunculosis, due to infection by scratching, is a quite frequent complication in children's asylums.

**Prognosis.**—The prognosis is good. It is very unusual for the most delicate child to succumb to the disease.

The institution infants who developed gangrenous dermatitis (Fig. 116) and a physician's child who developed erysipelas at the site of a chickenpox lesion presented the only fatal cases that have come under our observation.

**Treatment.**—Chickenpox is a disease for which very little treatment is required. During the eruptive period, and until the period of vesiculation is passed and the crusts have formed, the child should be kept in bed.

During the stage of active eruption the tub-bath should be omitted. Instead, gentle sponging with a tepid solution of boric acid—2 heaping tablespoonfuls of boric acid to  $\frac{1}{2}$  gallon of boiled water—will answer the requirement of cleanliness for a few days. After the daily sponging, and several times during the day, the areas affected should be anointed with boric acid ointment made with cold cream as follows:

R.	Mentholis.....	gr. x
	Pulveris acidi borici.....	gr. c
	Unguenti aquæ rosæ.....	3 ij.—M.

The ointment effectually relieves the itching, and doubtless is of value in preventing local skin infection through scratching. An equally effective remedy, but one less agreeable for domestic use, is a lotion of

5 per cent. ichthyol and sterilized olive oil. This is to be applied to the entire body twice daily after the bath. Objections to its use are the odor and the staining of the clothing and bed-linen. Permanent scars at the site of the vesicles are so rarely seen that no special precautions are required on this account.

### MUMPS (EPIDEMIC OR SPECIFIC PAROTITIS)

Mumps is a specific infection of the parotid glands.

Cocci have been isolated from the inflamed parotid gland in cases of mumps, but their specificity has never been proved. More recent studies point to a filtrate virus as the probable cause of the disease (Wollstein). The exact nature of the virus has not yet been determined.

Mumps affects chiefly the runabout and school children. Infants and very young children are rarely affected.

**Transmission.**—The disease may be conveyed by direct contact or through intermediary individuals, books, toys, or clothing.

**Incubation.**—The period of incubation is long—from two to three weeks.

**Duration.**—The duration of the disease from the commencement of the swelling until it has completely subsided is from ten days to two weeks.

**Quarantine** should be maintained until the swelling has entirely subsided.

**Pathology.**—As the great majority of cases are not fatal, it has been difficult to study the pathology of the disease. The pathologic changes that are known to occur are ordinarily limited to the salivary glands. There is edema and cellular infiltration of the connective tissue around the ducts and between the acini, while the glandular epithelium is often swollen and cloudy. The infiltration is most marked around the ducts.

When mumps affects the testis, the inflammation assumes a parenchymatous form, and when the epithelial degeneration in the tubules is severe, atrophic changes in this gland may follow. Occasionally the orchitis is accompanied by urethritis, edema of the scrotum, and inguinal adenitis.

Ovaritis, mastitis, and acute pancreatitis complicating mumps have been observed.

**Symptoms.**—Usually one gland is affected at first, and the gland first affected is usually the one most prominently involved, the second gland rarely reaching the size of the first and subsiding much earlier. In some cases, three or four days intervene before the second gland shows the characteristic swelling. The submaxillary glands may be involved in the process, but usually escape.

In one patient the submaxillary glands alone were involved. In another child three years of age both parotids and submaxillary glands and the sublingual gland showed massive involvement.

Involvement of other salivary glands than the parotid is more frequent during cold weather.

There may be prodromal symptoms of fever and languor. Difficulty is experienced by the patient in working the jaws. Not infrequently

there are sharp neuralgic pains and pains referred to the ear. An elevation of the temperature is usual during the acute stage, although this may not exceed  $100^{\circ}$  F. In most instances it does not exceed  $102^{\circ}$  F. If the glands are involved separately at two or three days' interval, there may be two distinct rises in temperature. The temperature is rarely sufficiently high to demand special treatment.

**Diagnosis and Differential Diagnosis.**—The patient presents a characteristic picture, the face taking on a rotund, rather ludicrous appearance, produced by no other malady. Acute adenitis of the lymphatic glands at the angle of the jaw is most frequently mistaken for mumps. Mumps, on the other hand, is not often mistaken for adenitis.

In history taking not infrequently one is told that the child has had two or three attacks of mumps, which means that the child has had perhaps



Fig. 117.—Mumps.

one attack of mumps, the others having been acute adenitis. In mumps the swelling, by involving the parotid, which it will be remembered is in front of and below the ear (Fig. 117), displaces the lobe upward and outward and completely fills the depression posterior to the lobe. In adenitis (Fig. 80) there is usually a well-marked depression between the swelling and the adjoining parotid.

Abdominal pain and vomiting in mumps should suggest pancreatitis rather than appendicitis.

**Complications** in mumps are exceedingly rare before puberty. Orchitis may occur in boys and ovaritis in girls, but only very exceptionally if the patient is kept in bed. Infection of the parotid other than that produced by the specific poison of mumps is extremely rare. Abscess as a complication due to a mixed infection has been reported. Nephritis is an occasional complication. One such case occurred in a boy two years

of age. Complicating pericarditis, endocarditis, and pancreatitis have been reported.

**Prognosis.**—The prognosis is good. We have never known a second attack, a relapse, or a death from the disease.

**Treatment.**—During an attack the child should be kept in bed until the temperature is normal, and should remain in the house until the swelling has entirely subsided. He should receive a reduced diet of broths, gruels, and milk, as in any illness with fever. Fruits and acids should not be given because of the discomfort they occasion. Unless the bowels move daily without assistance, citrate of magnesia or a Seidlitz powder should be given.

Warm applications at times relieve the pressure and discomfort. Flannel moistened with warm camphorated oil and bound to the parts has been acceptable to many patients.

### WHOOPIING-COUGH (PERTUSSIS)

As an infectious disease of importance, pertussis may be classed with diphtheria and scarlet fever. It is probably the cause of more deaths today than is any other infectious disease. It does not kill directly through a specific poison, as do diphtheria and scarlatina, but on account of its prolonged course and its many complications is equally effective as a life destroyer.

**History.**—Whooping-cough has existed from early times, under such names as “tussis perennis,” “tussis infantum,” “chink cough,” “chine-cough,” and “king’s cough.” In a treatise published in 1773 William Butter, of Edinburgh, aptly described “kinkcough” as “a quick and numerous succession of violent, short coughs followed by a long, strait, and generally shrill inspiration, which coughs and inspiration are repeated without intermission for many seconds or often some minutes and often terminate in the vomiting of phlegm.” Robert Watt, writing in 1813, stated that “next to the smallpox formerly, and the measles now, chin-cough is the most fatal disease to which children are liable.”

The seat of the affection was variously placed by the early writers in the nervous system, in the digestive organs, and in different portions of the respiratory tract. Butter believed that “miasms generated in the guts, act on the nerves” and “increase irritability.” Further information is proffered in statements that “measles render the kinkcough very dangerous”; “smallpox either cures or palliates”; and that “hemlock cures the kinkcough in a week.” A critic of the hemlock therapy ironically recalled that “the flesh of fried mice . . . has been in vogue as a specific.” Certain it is that even in very recent years no disease has been treated by remedies of wider diversity. Partial explanation of this fact undoubtedly rests upon the frequent association of whooping-cough with other diseases, as well as upon the varying therapeutic requirements of its more common complications.

**Bacteriology.**—The bacillus described by Bordet and Gengou in 1906 is at present generally accepted as the cause of pertussis. The bacillus is a short, ovoid, polex, regular, non-motile rod, which does not stain by Gram’s method. It is best isolated upon plates of potato-

agar mixed with rabbit's blood, as described by Bordet and Gengou, but later generations grow readily upon plain agar. The bacillus is present in the sputum in enormous numbers, and almost in pure cultures on the first two or three days after the onset of the whoop, and it may be found several days before the spasmodic stage begins (Wollstein). At the end of the first week of this stage, however, other bacteria, such as pneumococci and staphylococci, have usually become so numerous that isolation of the bacillus is impossible. Agglutination reactions with the patient's serum are irregular and unsatisfactory. Complement-fixation tests have been reported positive, but they are not regularly so.

Jochmann and Krause found the influenza bacillus in the sputum of pertussis patients in 100 per cent. of the cases they studied.

In children who have died during the spasmodic stage of an attack of pertussis the Bordet-Gengou bacillus has been found in the heart's blood and also in the lungs, where *Bacillus influenzae* is usually present as well.

**Transmission**, as with most of the communicable diseases, is by means of direct contact. That pertussis may be conveyed through the medium of clothing, a book, a toy, or a second person is exceedingly doubtful.

Extreme youth offers no protection as in the case of scarlet fever or diphtheria.

*Infective Period.*—The disease may be transmitted from the beginning of the catarrhal stage. The duration of the period of infection is not known. It probably continues in the average case until the child ceases to whoop.

When pertussis breaks out in a school or in an institution for children, prevention of an epidemic is practically impossible, because the disease is infectious during the early catarrhal stage, which lasts from one to two weeks. During this time the only symptom is a cough and perhaps a slight degree of bronchitis, such as exists with a common cold.

**Susceptibility.**—The previous state of health appears to exert no influence upon the patient's susceptibility. The strong and the delicate are alike predisposed to infection. The very young and the adult are less liable to take the disease than are children between the fourth month and the third year. This is the most susceptible period of life. Cases have been reported in children one week old. Any other concurrent infectious disease exerts no influence upon the duration of the pertussis. The theory has been advanced that the advent of diphtheria or scarlet fever during an attack of pertussis shortened and modified the course of the disease, but experience does not corroborate this belief. Other affections which occur during an attack simply increase the burden to be borne by the patient. The largest number of cases develop during the warmer months—from May to November. This circumstance may be accounted for in part by the fact that during the warm period of the year the infected child comes more frequently in contact with unprotected neighbors. The same circumstance, however, tends to disprove that catarrhal affections of the respiratory tract predispose to the disease, since respiratory affections in the young during the warmer months are notably rare. The normal healthy mucous membrane offers no greater

resistance to pertussis than does that which is affected by disease. In the early stages of pertussis there is not simply a bronchitis, but a catarrhal process due to a specific infection.

Interesting observations relative to susceptibility to measles and pertussis were made by Biedert. After a lapse of sixteen years both these diseases broke out in a German village at about the same time. There were 401 children in the village under fourteen years of age. These children had never been far from home, and not one of them had had either measles or pertussis. Of this number, 344 became ill with measles and 366 with pertussis, 340 having both diseases at once. The susceptibility of these unprotected children to pertussis was, therefore, 95.5 per cent.; to measles, 85.8 per cent. Of those who escaped pertussis, 7 were under five years of age, 4 between five and ten years, and 9 between ten and fourteen years.

**Pathology.**—There is very little characteristic pathologic change in uncomplicated pertussis. There is an inflammation and infiltration of the mucous membrane of the larynx and upper trachea, which is doubtless the seat of the specific infection. Mallory has affirmed that the specific lesion is the presence of *Bacillus pertussis* between the cilia of the epithelial cells of the trachea and bronchi.

**Incubation.**—The period of incubation is difficult to determine. It seems to range from seven to fourteen days.

**Symptoms.**—At the outset the cough may be short, hard, and of a paroxysmal nature. Usually, however, the cough is in no way characteristic and does not differ from that which accompanies bronchitis or tracheitis. Instead of improving under treatment, this symptom becomes more severe and more frequent. The child coughs more at night, usually, than during the day. In a week or ten days, rarely less than a week, the characteristic whoop occurs.

Fever depends on the degree of associated bronchitis.

A leukocytosis is common throughout the disease. The large mononuclear cells are characteristically increased in number and a moderate degree of eosinophilia is common.

Vomiting is a frequent associated symptom. It is mechanical in origin, not dependent primarily on gastric disturbance. For this reason the child may eagerly take and retain food almost immediately after vomiting. As the disease progresses the paroxysms increase in frequency and may occur even to the number of 50 or more daily.

**Duration.**—The paroxysmal stage remains at its height for a period ranging from one to four weeks. Beginning improvement is always marked by a diminution in the frequency and severity of the seizures.

**Complications.**—The complications of pertussis are many, and account for the fact that the disease is so destructive to life. The most fatal complication in winter is bronchopneumonia; in summer, gastro-enteric disease. Convulsions are not an infrequent complication, and may be fatal. Malnutrition often follows a severe attack in a delicate, bottle-fed child, thus paving the way for intercurrent disease. Tuberculosis not infrequently follows a prolonged attack of pertussis. Blindness, deafness, and motor disturbances have all been observed during attacks of pertussis, and have been followed by complete recovery. These cases may be explained as

follows: During a severe paroxysm the cerebral circulation is greatly disturbed, and as a result of an extreme congestion or venous hyperemia there is a disturbance of nutrition in certain portions of the brain. Epistaxis is frequent and in rare instances cerebral hemorrhage with resulting permanent paralysis has occurred. On the cessation of the paroxysm these symptoms all disappear.

**Diagnosis.**—The diagnosis of pertussis is most difficult in the early stages, before the whoop or convulsive paroxysm develops. Even a spasmodic cough does not always mean a developing pertussis.

In rachitic children, and in those in whom the nervous element is prominent, the cough of an ordinary cold is often of a decidedly paroxysmal character, especially when there is an acute or subacute laryngitis.

The cough, however, if more troublesome at night, favors a diagnosis of pertussis. If the diagnosis is correct, the cough grows steadily worse and resists the usual treatment of colds.

The mild cases are also difficult of diagnosis.

*Illustrative Cases.*—Two patients, aged eight and ten years respectively, went through an attack of pertussis with but two or three severe paroxysmal coughing attacks.

Two other cases seen in private practice also show how mild may be the course. The patients, brother and sister, aged six and eight years respectively, commenced coughing about ten days after exposure. The cough was paroxysmal, with from three to five seizures in twenty-four hours. The boy whooped only three times during the entire course of the disease; the girl did not whoop at all. Vomiting never occurred with a paroxysm. Both patients coughed for six weeks. They had neither adenoids nor bronchitis.

Often the very young and the very delicate do not whoop, even during a severe attack. Among the severe cases convulsions and hemorrhage from the nose, ears, and eyes are seen from time to time.

A very severe seizure in a girl nine months old was followed by small extravasations of blood into the skin of the entire body.

**Differential Diagnosis.**—In all cases of severe cough of uncertain origin the nasopharyngeal vault must be examined for adenoid growths. In young children this can be properly done only by the use of the index-finger.

The presence of enlarged bronchial glands, whether of tuberculous origin or the result of prolonged respiratory infection of the streptococcus or influenzal type, may also readily account for persistent cough of the pertussis character. *x*-Ray is of great value in the differentiation of such cases.

As a general rule, the presence of a persistent cough with a paroxysmal tendency, in the absence of local respiratory irritation of any nature, and accompanied by eosinophilia, is very suggestive in a suspected case.

**Prognosis.**—Pertussis in children under eighteen months of age must ever be regarded in a serious light. Delicate and rachitic children should be carefully guarded against the disease. Bronchopneumonia and gastroenteric troubles are the most frequent complications among this class of children. The majority of healthy children over eighteen months of age bear whooping-cough without great inconvenience.

Breast-fed babies tolerate the disease in the early months of life far better than do those artificially fed.

**Treatment.**—The use of *drugs* in whooping-cough has always been more or less of a disappointment. By their use, however, the paroxysms may be lessened in number and severity and the illness may be made easier for the patient to bear, which of course is important. Good results have been obtained by the use of antipyrin and bromid of soda in combination as follows:

For a child eight months of age,  $\frac{1}{2}$  grain of antipyrin with 2 grains of bromid of soda are given at two-hour intervals—six doses in twenty-four hours; for a child of fifteen months, 1 grain of antipyrin and  $2\frac{1}{2}$  grains of bromid of soda at two-hour intervals—six doses in twenty-four hours; from the fourth to the eighth year, 2 grains of antipyrin and 5 grains of bromid of soda at two-hour intervals—six doses in twenty-four hours.

Quinin has been used in a large number of cases in both private and outpatient work. Great benefit may be derived from its use if a large amount can be given. Its administration, however, is attended with difficulties. Twelve to 20 grains in twenty-four hours are required for pronounced results in children from two to six years of age, and the administration of such a large amount is not favorably received by many parents. Again, our inability to make the drug palatable is a serious drawback for any age, and almost excludes its use in the very young; furthermore, in the very young and delicate quinin may derange the stomach and produce vomiting. A good form of solution to use is that of bisulphate in Yerbazin, or a similar preparation "Coca-quinin" (Lilly). In older children, when quinin can be given in sufficient quantities in capsules, the decrease in the number and severity of the paroxysms is sometimes surprising.

Codein is to be used in the most severe forms of pertussis when other means fail to relieve the patient. One of the most troublesome features of the disease in infants and young children is the wakefulness at night caused by repeated attacks of coughing and vomiting. When the child cannot sleep, codein is advisable independent of the other treatment, whatever it may be. For a patient five years of age  $\frac{1}{8}$  grain is to be given at bedtime and repeated during the night whenever the paroxysms require. For a child from eight to twelve years of age,  $\frac{1}{2}$  grain may be given at bedtime and repeated twice if necessary. For a child from two to three years of age,  $\frac{1}{16}$  grain may be given and repeated not oftener than twice during the night. The drug should not be continued longer than a week or ten days. We have never seen unpleasant effects follow its use.

*Interrupted Medication.*—It will be observed that the drugs of value in whooping-cough are the sedatives. For the reason that by the prolonged use of sedatives their effect is lost, it has been found wise to use what may be called "interrupted medication." For five days the antipyrin and bromid of soda are given. Full doses of quinin only are then given for five additional days, at the end of which time the antipyrin and bromid are resumed. In this way, giving the drugs five days each, one may continue with advantage for a month or six weeks. It is rarely necessary to continue the treatment longer than six weeks—usually from three to

four weeks is sufficient. Of course, the child will whoop after that time, but the active stage of vomiting and severe paroxysms will be over. If the vomiting can be controlled in an attack of pertussis, and if the patient can obtain sufficient sleep, much has been accomplished.

What has already been suggested should be emphasized: *Do not begin the drug treatment of whooping-cough*, whether by the administration of quinin, antipyrin, or other remedies, *until the spasmodic stage is at its height*. If a sedative is given as soon as a diagnosis is made, by the time the disease reaches its height tolerance will have become so established that the drug will have lost not a little of its sedative action. If medicines must be given during the earliest stage, a placebo may be used.

*Fresh air* is of immense value as a means of relief in whooping-cough, regardless of the method of treatment followed. We are told that the child rarely coughs when out-of-doors, but commences as soon as he is brought into the house, which is usually overheated and badly ventilated. In nearly all cases the cough is worse at night. This may be explained in part by the absence of proper ventilation in the sleeping apartment. A child who for any reason must remain indoors should not be allowed to remain constantly in one room. There should be two rooms and every window in the one not in use should be freely open. The living room and sleeping room should be kept at a fairly even temperature—from 68° to 70° F.

*Vaccine*.—Our opinion as to the value of vaccine in pertussis has undergone a series of changes. We confess to periods of enthusiasm and again to those of doubt, which implies that as a remedy vaccine is variable in its apparent effects. It is most difficult to judge whether a remedy is adequate when the improvement noted may be explained in several different ways. We have seen what appeared to be brilliant results directly due to vaccine, although repeatedly following its use no response whatever has been apparent. It is to be remembered that whooping-cough varies greatly in its severity and response to ordinary treatment.

For prophylactic purposes two doses are usually given, the first injection consisting of 1,000,000,000 organisms and the second of 2,000,000,000 given forty-eight hours after the first.

Injections for curative purposes are ordinarily given at two-day intervals to the number of four or five in all, the dosage ranging from 500,000,000 at the first injection to four to six times this amount at the last treatment.

Freeman has laid emphasis on the importance of employing only freshly prepared vaccine.

By numerous experienced observers preference is given to a glycerol vaccine.

**Quarantine** in whooping-cough is particularly difficult, but in some adequate degree should be maintained, even if the precaution taken consists only in making the patients wear an arm band labeled "whooping-cough." A fair rule is to isolate the child during the spasmodic stage and at least two weeks after the whooping begins.

Practical success in limiting the transmission of the disease has been attained by attempts to keep well children away from those with suspicious coughs, rather than by actual isolation of the latter.

## MEASLES

By some writers measles is credited with an antiquity as great as that of smallpox, but the fact that measles was long confused with other exanthemata renders it doubtful whether descriptions over two centuries old should be accepted. Measles has always been one of the most rapidly advancing of epidemic diseases. In communities long unaffected, such as Iceland and the Fiji Islands, it has attacked the greatest numbers and developed the highest virulence. In the years 1834 to 1836, and 1842 to 1843, nearly the whole of Europe was invaded.

Buxton, whose elaborate little monograph, published a century and a quarter ago, still affords much of value, said: "Those who die of measles generally receive their death by a great flux of serum to the lungs." Certain it is that bronchopneumonia has always given to measles an importance out of all proportion to its immediate severity.

**Transmission.**—Measles is the most readily transmitted of all the communicable diseases. A very few seconds' exposure is all that is necessary. Very few of the human race escape. The disease is transmitted by direct infection. Transmission through an intermediary is not of frequent occurrence. We have never known a proved case.

The disease may be transmitted from the beginning of the earliest catarrhal symptoms, which become manifest two or three days before the appearance of the rash. The most infective period is during the first four or five days; how much longer it may continue is unknown.

**Etiology.**—Goldberger and Anderson were able to produce measles in rhesus monkeys by inoculating them with the blood of human patients with the disease. These investigators proved that the blood in measles is infected before the appearance of the rash and during efflorescence of the eruption, while the infectivity decreases twenty-four hours after the eruption has appeared. The buccal and nasal secretions are also infective at the time of the appearance of the eruption and for forty-eight hours afterward. The desquamating scales, on the other hand, were not found infective. The nature of the virus has not been proved, but it is filtrable through a Berkefeld filter, resists drying for twenty-four hours, and becomes inert after fifteen minutes' exposure to 55° C.

Lucas and Prizner confirmed the work of Anderson and Goldberger, and showed further that the inoculated monkeys develop Koplik spots just as do human subjects.

Blake<sup>1</sup> has successfully transmitted measles experimentally in monkeys through a considerable series of animals by nasopharyngeal washings, tissue emulsion and blood, with the resulting lesion histologically similar to measles in man.

**Age.**—No age is exempt. In scarlet fever and diphtheria, nature surrounds the very young with a certain degree of immunity. Numerous young infants are, however, susceptible to measles, although this disease almost never occurs in those under three months of age. According to Herman<sup>2</sup> infants under two months of age whose mothers have had measles are absolutely immune, although practically all after the ninth month contract the disease on exposure.

<sup>1</sup> Francis G. Blake, Measles Experimentally Produced, Arch. Ped., 38, 1921, pp. 90-102

<sup>2</sup> New York State Jour. of Med., 23, No. 10, October, 1923, pp. 404-407.

**Incubation.**—The period of incubation ranges from seven to fourteen days. It is rare for the disease to develop after the tenth day following exposure. A few cases develop, however, as late as the fourteenth day.

**Symptoms.**—In marked contrast to scarlet fever, measles is fairly constant in its manifestations. Very severe cases and very mild cases are encountered. Institutional children have measles much more severely than do private patients, and the former cases are much the more fertile in complications. This is because of the natural disadvantages which an institution necessitates, no matter how well it is conducted. The complications are more frequent because of the more frequent presence of secondary infection to produce the complications.

**The Eyes.**—The first manifestation of the illness is a coryza with mild conjunctivitis. The eyelids become swollen and reddened at the margins. There is photophobia.

**Cough.**—A cough is present from the beginning or develops in a short time. The cough is hard, teasing, and, early in the attack, without bronchial secretion. Occasionally the cough is hoarse and croupy, but this is of rare occurrence.

**Nervous Manifestations.**—Headache is not uncommon. Convulsions occur very rarely, and when present are usually due to indigestion. The child is very restless and unhappy until the eruption is well developed.

**Buccal spots,** described by Filatow and by Koplik (see Plate II), preceding the exanthem by three to five days are pathognomonic.

**The Rash.**—The characteristic rash usually makes its appearance about the ears and over the face, neck, and upper portion of the chest. Thence it spreads to the entire body, the last portions involved being the feet and hands. In its disappearance, the rash follows the same order. It consists of red papules and macules of irregular shape and of variable size. Early in all cases, and throughout most mild cases, there are areas of uninvolved skin between the erupted areas. In severe cases the areas of eruption coalesce so that the face, trunk, and limbs or the entire skin surface may present a livid, deeply congested appearance. The face, covered with the diffuse rash, swollen and edematous, with the swollen eyelids closed and secreting, and the thin, watery nasal discharge presents a picture seen in no other disease.

The rash is sometimes quite irregular in the time of its appearance after the onset of symptoms. It may occur very early, coincident with the onset of the catarrhal symptoms, or it may be delayed for a week. The eruption requires from three to six days to complete development.

**Temperature.**—Pronounced fever does not ordinarily develop until the appearance of the rash. Both the temperature and the rash reach their greatest intensity at the same time. Rarely there is a prodromal fever for a few hours which may reach 103° to 104° F. This fever subsides quickly and the indications are that the exposed child will not develop the disease. Within forty-eight hours, however, or less, the temperature again begins to rise with the appearance of the rash. In cases of this nature difficulty has been experienced at the outset in persuading parents of the necessity of keeping the child in bed, or even in the house, as the illness is looked upon by the family as a cause of false alarm.

**Diagnosis and Differential Diagnosis.**—The diagnosis in most cases of measles is not difficult. A mild case may closely simulate one of severe German measles. The presence of Koplik spots (see Plate II) on the buccal mucous membrane, the conjunctivitis, and cough are usually sufficient to mark the case as one of true measles.

There are no other skin manifestations that simulate those of measles sufficiently to occasion confusion.

**Complications.** Children with measles almost always have some bronchitis. In fact, a mild degree of bronchitis occurs so regularly that it may be looked upon as part of the disease.

*Bronchopneumonia* is the most frequent complication, because the diseased mucous membrane of the respiratory tract becomes a fertile field for infection with pneumococcus and other pathogenic bacteria. The mortality in institutions for children with measles is always large, because of the complication of bronchopneumonia. In an epidemic of measles thus complicated, in a New York institution for children, there was a mortality of 40 per cent.

In a series of 3080 cases of measles reported by Mixsell and Giddings<sup>1</sup> from the service of the Willard Parker Hospital there were 826 cases of pneumonia, 26.8 per cent., with a mortality of 424, 51.33 per cent. Both lobar and bronchopneumonia were included.

*Otitis.*—Acute, simple, and suppurative otitis is a fairly frequent complication. Its presence should be suspected when the temperature is continued and does not subside with the disappearance of the rash. The absence of pain does not mean that the ears are normal. In a large percentage of our cases of suppurative otitis in young children pain has been absent.

*Nephritis* is a very rare complication. We have seen but one case.

*Adenitis* is a rare complication.

#### **Recurrence or Second Attack:**

One recurrence after a two-year interval was observed in a girl seventeen years of age. The second attack was very severe, and followed by a moderately severe nephritis. The family, most intelligent and reliable people, insisted, moreover, that the girl had had measles in childhood, together with other members of the household. If such was the case, she had three attacks of measles.

A brother of the patient also had two attacks of the disease.

**Prognosis.**—The prognosis is good in the cases in which pneumonia does not enter. We have never known a fatal uncomplicated case of measles.

**Treatment.**—*Serotherapy.*—A review of this form of treatment in its application to measles has been made by Ratnoff.<sup>2</sup> The method has been developed since 1915 by a number of investigators working independently, and since 1919 has been standardized by Degkwitz. Serum obtained from the blood of children seven to fourteen days after the establishment of convalescence from measles is administered subcutaneously to exposed children, if possible four days after the known exposure, in dosage of 2 to 5 c.c.

The immunity thus conferred is undoubted. In a few cases symp-

<sup>1</sup> Southern Med. Jour., February, 1923, pp. 90-94.

<sup>2</sup> Serotherapy in Measles, Arch. Ped., xl, 10, October, 1923, pp. 683-691 (Bibliography).

## PLATE II



FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

### THE PATHOGNOMONIC SIGN OF MEASLES (KOPLIK'S SPOTS).

FIG. 1.—The discrete measles spots on the buccal mucous membrane, showing the isolated rose-red spot, with the minute bluish-white center, on the normally colored mucous membrane.

FIG. 2.—Shows the increased eruption of spots on the mucous membrane of the cheeks; patches of pale pink interspersed among rose-red areas, the latter showing numerous pale bluish-white spots.

FIG. 3.—The appearance of the buccal mucous membrane when the measles spots coalesce and give a diffuse redness, with myriads of bluish-white specks. The exanthema is at this time fully developed.

FIG. 4.—Aphthous stomatitis sometimes mistaken for measles spots. Mucous membrane normal in color. Minute *yellow points* are surrounded by a red area. Always discrete.

(The Medical News, June 3, 1899.)



toms of mild abortive measles develop in the exposed subjects treated with the serum, but in most instances no signs of the disease are to be noted. In Ratnoff's series of more than 100 cases no "single typical fully developed case of measles" occurred. Degkwitz obtained the most potent protective serum from adult convalescents.

There is ample evidence also from the consistent success now obtained by the New York Health Department to warrant the wide-spread adoption of this method of prophylaxis, provided precaution be observed that the serum be taken from subjects free from all constitutional disease other than measles. The Wassermann and tuberculin tests should be employed in fulfilling this precaution.

The duration of the immunity conferred is variable and apparently greater in the cases in which the injections are given six days after exposure than in those receiving the treatment earlier. The evidence indicates that lasting immunity is not conferred, although the possibility of reinforcing temporary immunity by later injections has already been the subject of study.

*General Management.*—The popular conception of the management of measles is that the patient should be warmly wrapped, given hot drinks, and kept in a warm room with little or no ventilation. An attack of measles renders the child temporarily very susceptible to bronchopneumonia. The younger and more delicate the child, the greater the danger. The darkened room, with its closed windows and dust, the extra wrappings, with the resulting failure of heat radiation, the reduced vitality, and the resulting loss of appetite do much to prepare the way for an infection of the respiratory tract, which so often occasions bronchopneumonia. If to a case of this nature whooping-cough be added, we have, with few exceptions, a hopeless condition.

A child ill with measles should be comfortably clad in the usual night-clothes and kept in bed. No extra wraps are required, nor is it desirable to keep the room warmer than is customary—68° to 70° F. being a suitable temperature. There are many gradations of light between glaring sunlight and utter darkness. Both are extreme and one almost as undesirable as the other. It is desirable that a window-shade of dark green be lowered within one foot of the window-sill. A light brown or drab shade should be lowered completely. If the shade is white, or of a very light color, and not supplemented by a curtain of dark material, it will be necessary to exclude the bright light by some other means. The child, if old enough, may dictate the degree of light, inasmuch as any intelligent child will know when the light is painful.

*Feeding.*—For the bottle fed, the milk mixture should be diluted at least one-half by adding boiled water, and the same quantity given as in health. The appetite in the early stage of measles is practically absent, so that little or no food is taken. Patients may be given water to drink freely at a temperature not lower than 50° F. For "runabout" children, eighteen months of age and over, the diet as suggested for the sick (see p. 154) should be given.

*Bowel Function.*—There should be one evacuation of the bowels daily. An enema should be given when defecation does not otherwise take place. The *urine* should be examined every second day.

*The Eyes.*—During the waking hours the eyes should be generously bathed every hour or two with a 3 per cent. solution of boric acid applied with old linen or cotton, which is afterward destroyed.

*The Ears.*—Otoscope examination should be made every second day until the case is discharged. In the event of a sudden rise in temperature during convalescence, which cannot be explained by the condition of the intestine, lungs, or throat, such an examination should be made by an expert.

*Baths.*—The temperature of uncomplicated measles is rarely high enough to call for special measures. If it should have a tendency to continue about 104° F. after the rash is well developed, and the child be uncomfortable and restless, a tepid sponge-bath of ten or twenty minutes' duration may be given. Whether the fever demands bathing or not, the patient should be sponged once a day with tepid water at 100° F. After the drying an application of cold cream, liquid petrolatum, or olive oil should be made to the entire body. This is to be given for the sole reason that it relieves the itching, induces sleep, and thus enables the child to pass through the disease with less discomfort.

*Delayed Rash.*—Now and then a case is encountered in which the rash is slow in appearing. The temperature is high—104° to 105° F.—the skin hot and dry, and the child very uncomfortable, perhaps delirious. In such an event a hot bath—105° to 110° F.—of from three to five minutes' duration, often brings out the rash and greatly relieves the symptoms, which may have been of an urgent character. On removing these children from the bath care must be exercised to keep them wrapped for fifteen to twenty minutes in a blanket which has previously been warmed.

The *cough* during the active period of the attack is one of the annoying features of the disease, for which some relief must be attempted, particularly if the child is kept awake at night. The ordinary expectorants alone are of no service in treating the cough of measles. Only a sedative will give relief. To a child six months of age from 5 to 8 drops of paregoric may be given, and repeated if necessary after an interval of two hours. The following combination of paregoric and sweet spirits of nitre is often of service:

R. Tincturæ opii camphoratæ..... gtt. x  
Spiritus ætheris nitrosi..... gtt. iij

M. Sig.—One dose; to be repeated every two or three hours (for a child of eighteen months or older).

From the first to the second year, 10 to 15 drops of paregoric or  $\frac{1}{2}$  grain of Dover's powder may be given at two-hour intervals, if required. Usually but two or three doses of the sedative will be necessary during the night. Should the paregoric or Dover's powder be objectionable because one may dislike to give opium to young children, from 3 to 4 grains of sodium bromid in 2 drams of water, repeated as required every hour or two, will be of service for a child under two years of age. From the second to the fifth year 1 grain of Dover's powder, or from 15 to 25 drops of paregoric, or 1/10 to 1/6 grain of codein, may be given at intervals of from two to four hours.

If bronchitis develops sufficiently to require treatment, as it does in at least one-half the cases, the means for the management of bronchitis suggested on p. 343 will be found useful. The temperature of a child ill with measles should be taken three times daily, and the lungs and heart should be examined every day.

*Vapor.*—It is excellent practice to keep the air of the sick-room moistened with vapor during the entire illness. The benefits are twofold: Vapor relieves the cough, being more agreeable than dry air to the congested mucous surface during the early stage; and it prevents the free circulation of dust, the danger of which has already been referred to. If the room is carpeted, it should be well sprinkled with water before sweeping. If, fortunately, the floor is bare, the broom can be dispensed with, and a damp cloth used instead.

*Fresh Air.*—Not only should the air of the sick-room be vapor-charged, but it should be frequently changed through proper ventilation.

*Quarantine.*—The length of quarantine is usually seven days from the onset. In some communities an isolation period of twenty-one days is enforced upon exposed children.

### GERMAN MEASLES (RÖTHELN; RUBELLA)

German measles is a disease of the runabout and school-child, rarely occurring in infants. It is one of the mildest diseases of the transmissible class.

*Etiology.*—The specific etiologic agent of German measles is quite unknown, but that it is not identical with that of either measles or scarlet fever is evidenced by the fact that an attack of rubella does not protect against either of these diseases.

*Transmission* is by direct contact. We have never had proof of the transfer through an intermediary and have never known of a second attack in the same patient.

*Incubation.*—The period of incubation is from two to three weeks.

*Symptoms.*—The first symptom is usually the rash. The temperature rarely goes above 101° F. In a very few cases it rises to 103° F., usually at the onset of the illness. The catarrhal symptoms are negligible. There is rarely more than a slight injection of the conjunctiva.

The *rash* is not only the first manifestation of the disease, but it remains the principal evidence of the infection. The eruption closely resembles that of measles, and differentiation between the two diseases from the standpoint of the rash may be difficult. It usually appears first about the ears and neck and spreads rapidly. The eruption at first is distinctly smaller and less crescentic than that of measles; it is papular and varies from a faint red to a deep red color; rarely it is distinctly punctate. When this is the case, the erupted areas may coalesce, producing a diffuse blush not unlike that of scarlet fever. The eruption is usually very temporary, lasting from one to three days and disappearing after the order of its appearance, leaving the face and the neck first. There is no resulting pigmentation or discoloration of the skin, such as may occur in true measles.

There is no involvement of the buccal surfaces except for a slight

punctate red rash which may be seen on the soft palate early in the disease.

*Lymphatic Gland Enlargement.*—Enlargement of the glands at the angle of the jaw and the post-cervical glands, particularly the latter, occurs so consistently that this condition may be put down as one of the prominent symptoms of the disease. The glandular involvement, however, is very slight, and disappears in from two to four days. The glands in the axilla and groin very rarely show involvement.

*Desquamation.*—Only the severe cases are followed by a slightly branny desquamation.

*Diagnosis and Differential Diagnosis.*—The disease may be confused with measles, scarlet fever, and the indigestion and drug erythemata. The mildness of the symptoms is a strong point in favor of German measles. Exceptionally, a severe case may be difficult to differentiate from true measles. In such an instance the absence of eruption on the buccal mucous membrane (Koplik spots) is a valuable aid. Further, the typical post-cervical lymph-gland enlargement does not occur in measles.

*Scarlet Fever.*—The characteristic angina, which is a fairly constant symptom in scarlet fever, is never present in German measles. There is no post-cervical gland enlargement early in scarlet fever; and while the rash of German measles may resemble that of scarlet fever, the former exanthem is coarser in appearance, the punctate dots are larger, and the rash presents a blotched appearance, in contradistinction to the general diffuse intense blush of scarlet fever. In scarlet fever, furthermore, the desquamation is characteristic.

*In erythema due to drugs* there is no manifestation of illness of any nature.

*A rash due to indigestion* is very transient and is apt to be urticarial in type.

*Complications.*—We have never known a complication to develop with this disease.

*Prognosis.*—We have never known a fatal case.

*Treatment.*—Rest in bed for about two days, confinement to the house for a slightly longer period, reduced diet, and the promotion of free bowel action are usually all that are needed. Recovery is ordinarily complete in six to eight days from the beginning of the attack.

*Isolation* is not a necessity unless there are very young or delicate children in the family.

## DIPHTHERIA

Diphtheria has been known by its present name for less than a century, although the terms "*ulcus Syracum*" and "*ulcus Egyptacum*," together with references to certain anginas with very peculiar expectoration, indicate that the disease was prevalent as far back as the time of Hippocrates. As early as 100 B. C. Asclepiades, of Bithynia, quoted by Galen and Aretæus, is said to have known diphtheria and practised laryngotomy. Aretæus gave the first important description of "*angina gangrenosa*," and Galen, in the second century, described the membranous expectoration.

Not, however, until the early part of the eighteenth century did

study of the disease become productive. In 1719 Wolfgang Wedel, of Jena, issued a document on the value of isolation. A little later an epidemic near Boston, and in 1745 another in Paris, resulted in the description of cutaneous diphtheria and of paralysis of the palate and eye muscles. Home accurately described the membranes in 1765 and invented the term "croup," to differentiate the condition under discussion from the "angina maligna" or "gangrenosa" of ancient writers. Not until the publication in 1826 of Bretonneau's famous treatise on the epidemics at Tours was the pathology of the disease accurately defined. Bretonneau combined all the inflammations previously called angina gangrenosa, ulcers, and croup under the term "diphtheria" (*Διφθῆρα*, a membrane) and asserted his belief that direct inoculation and contact were the only modes of transmission.

The later history of diphtheria contains its two most important epochs: the discovery by Klebs of the bacillus, in 1883, with its isolation and cultivation by Löffler in 1884; and the introduction of antitoxin into general use as a result of long experimentation (by Behring, Roux, Martin, Chaillon, and Yersin) with the serum of actively immunized animals. Since the report of Roux in 1894 that in certain hospitals antitoxin had reduced the mortality from 58 per cent. to 20 per cent., the wider and more intelligent use of this specific has revolutionized the disease.

**Age.**—Diphtheria is of rare occurrence before the first year, although no age is exempt. Our youngest patient was five months of age. A case in the practice of a colleague occurred at the sixth week. The most susceptible age is between the second and tenth year.

**Predisposition.**—Vigor of constitution appears to exert no influence on susceptibility to the disease. The strong and the delicate are alike subject to the infection. Zingher's investigations with the Schick test, however, have demonstrated a larger proportion of susceptible children among those living in the less populous, better communities than in dense tenement districts where the children have had mild undiagnosed attacks.

**Diseased Throats.**—The presence of diseased tonsils and adenoids appears to be a decided predisposing factor. Throats so involved possess a poor resistance to the infection. It is apparent that a normal throat is a valuable prophylactic agent, which means that children whose diseased tonsils and adenoids have been removed have the best chance to escape after an exposure.

**Transmission.**—Diphtheria is both transmissible directly through contact, and indirectly through an intermediary. Transmission from the diseased to the well is usually through personal association. That the disease may also be transmitted through an intermediary person, book, or article of clothing, is not to be questioned. Nevertheless, secondary sources of exposure are undoubtedly much less a factor than is generally accepted. Diphtheria may be so mild in an individual that its presence is not suspected, and to such mild ambulatory cases is due in many instances the spread of the disease.

**Diphtheria Carriers.**—In many instances the presence of the diphtheria bacillus is demonstrable in the nasal secretions of healthy children. In a series of observations upon public school children in Baltimore Styles found diphtheria bacillus in 5 per cent. of cases.

**Bacteriology.**—The morphology of the Klebs-Löffler bacillus varies greatly, but it has a characteristic irregularity of staining and regularity of grouping which are aids to diagnosis. Its demonstration in smears or cultures from the site of the lesion is a necessity for the diagnosis of diphtheria. With the weakly alkaline methylene-blue stain recommended by Löffler the bacilli appear striped, unevenly beaded, granular, or clubbed. They are arranged in groups of four or six elements, lying parallel or at sharp angles.

The most frequent localization of *Bacillus diphtheriæ* in the human body is on the mucosa of the throat, larynx, and nose. The infection may travel down into the lung, causing bronchopneumonia, or into the stomach, causing pseudomembranous gastritis. The bacilli have been found in pus from the middle ear, and the pseudomembranous lesions on the skin and vulva. Exceptionally the conjunctiva is infected. As a rule, *Bacillus diphtheriæ* remains localized at the site of the lesion it has produced, and only in very rare instances does it invade the blood—probably as a terminal condition. The toxin formed by the bacillus is responsible for the general symptoms.

The bacillus may persist in the throat for weeks after an attack of diphtheria, however mild such an attack may have been. These bacillus carriers become a menace to other persons, since a mild attack of diphtheria in one individual may yet produce a severe case in another person.

**The Schick Test and Toxin-antitoxin Immunization.**—In the Schick test a minute quantity of diphtheria toxin is introduced intradermally. The effects indicated by a local reaction determine the susceptibility of the individual to diphtheria. Toxin-antitoxin injections are employed to confer active immunity upon those who are susceptible.

*Susceptibility to Diphtheria.*—As mentioned elsewhere very young infants have been looked upon as possessing a natural immunity to diphtheria. Among several hundred cases but two were seen under six months of age.

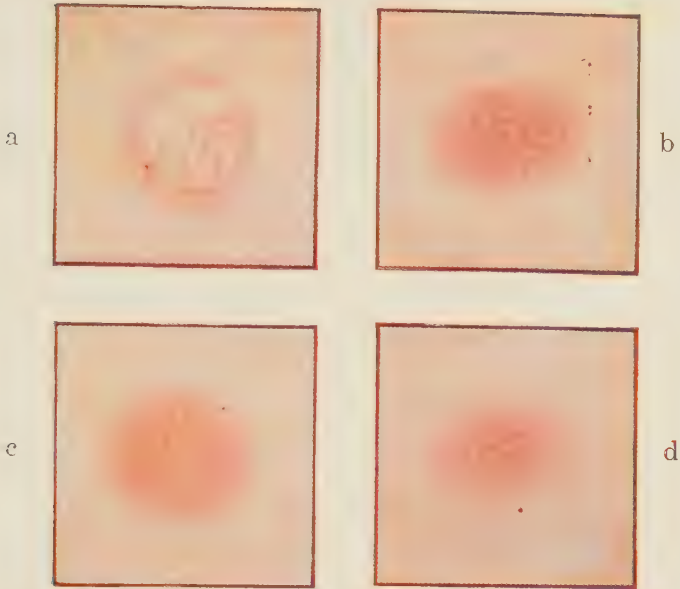
Interesting observations as to the susceptibility of children at various ages have been published by Schick, as follows:

Age.	Total.	Schick's.	Positive Schick's.	Per cent. positive.
Newborn.....	291	275	16	7
First year.....	42	24	18	43
2 to 5 years.....	150	55	95	63
5 to 15 years.....	264	133	131	50
Totals.....	747	487	260	34.9

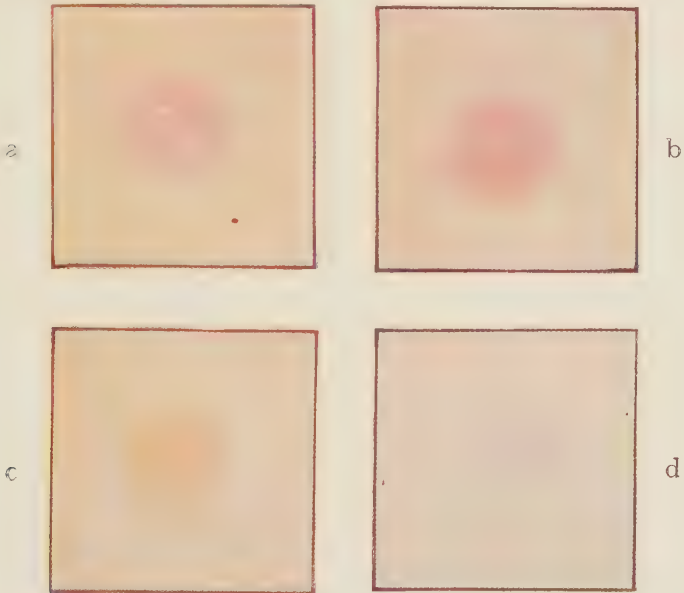
It will be observed that in the newborn but 7 per cent. were susceptible to diphtheria. Among 747 children under fifteen years but 34.9 per cent. were susceptible to the disease.

It has been proved that an attack of diphtheria not only causes no immunity, but renders the individual more readily susceptible to future attacks.

# PLATE III



Shows four typical positive Schick reactions of varying degrees of intensity forty-eight hours after test; (a) is a strongly positive reaction, with vesiculation of the surface layers of the epithelium, which is seen occasionally in individuals who have practically no antitoxin; (b) and (c) are positive reactions; (d) a moderately positive reaction.



Shows a fading positive Schick reaction one to four weeks after test in various stages of scaling and pigmentation; (a) shows redness, scaling and beginning pigmentation after one week; (b) and (c) pigmentation after two and three weeks; (d) faint pigmentation after four weeks.

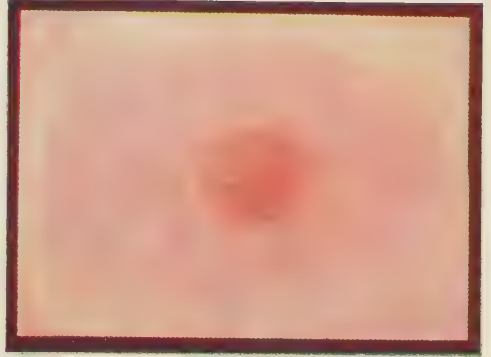
(ZINGER, American Journal of Diseases of Children, April, 1916.)



PLATE IV



a



b



c

Shows two pseudoreactions forty-eight hours after test, and a combined reaction; (a) mild; (b) marked; (c) a combined positive and pseudoreaction.

(ZINGER, American Journal of Diseases of Children, April, 1916.)



It has also been demonstrated that susceptibility runs in families. When one child in a family is Schick-positive others are apt to be positive, and the same holds with negative reactions.

*Technic.*—Schick published an elaborate technic which was not practicable for ordinary purposes. Park and Zingher have simplified the technic and this, with slight modification, has been employed on a large scale in the testing of many thousands of children in the New York schools.

The toxin is supplied in capillary tubes. The contents of a tube is mixed with 10 c.c. of sterile salt solution and 0.2 c.c. of the solution is injected intradermally with a fine hypodermic needle.

There may be three results following intracutaneous injection of diphtheria toxin:

*Negative.*—Where no local reaction at all occurs about the injection point.

*Pseudopositive* (Plate IV) (meaning not positive at all).—Where a red area, probably anaphylactic in character, appears within the first twelve to twenty-four hours, but disappears in thirty-six to seventy-two, with little or no pigmentation.

*Positive* (Plate III).—Where in thirty-six to forty-eight hours a red, generally clearly outlined area about  $\frac{1}{2}$  to 2 cm. appears about the injection point, which lasts, becoming a brick red in two, three, or four days, the skin then wrinkling and scaling, after which the discoloration gradually disappears, taking three to six weeks to entirely disappear.

Negative signifies immunity. *There is sufficient antitoxin in the system to neutralize the poison introduced.*

Pseudopositive also signifies immunity.

Positive signifies *no* immunity. *There is not enough antitoxin in the system to neutralize the poison introduced.* The individual reacting positive is susceptible to diphtheria. A *combined reaction* (Plate IV), representing the positive and pseudo-reaction in the same individual and showing evidences of a true reaction after the pseudo-element has disappeared, indicates absence of immunity.

According to Zingher<sup>1</sup> three prerequisites are necessary for the test: (a) a reliable toxin, (b) a proper technic, and (c) a correct interpretation of the reaction. Care in getting and keeping the toxin will answer the first. A good syringe (preferably a 1 cc.), and a fine, sharp but short-beveled platinum-iridium needle are needed for the second. The ability to carry out the test properly is easily acquired. One point that may serve in guiding one in the injection of the diluted toxin might be emphasized. If the needle has been inserted in the proper layer of the epidermis, then the oval opening of the needle will be visible through the superficial layers of cells. A definite wheal-like elevation, with the distinct markings of the openings of sweat-glands, shows that the injection has been made properly, and that the fluid is confined to a small area of the epidermis. Here it will exert its irritant action if the individual tested is not immune to diphtheria.

*Summary and Conclusions.*—The following statements quoted from Park<sup>2</sup> present concisely the results of twenty-five years' investigation of the immunizing effect of toxin-antitoxin injections and the value of the Schick test:

"Three injections, 1 c.c. each, of a suitable toxin-antitoxin mixture spaced one or two weeks apart, will cause about 85 per cent. of susceptible children or older persons

<sup>1</sup> Amer. Jour. Dis. of Child., 11, 269, April, 1916.

<sup>2</sup> Jour. Amer. Med. Assoc., vol. 79, No. 19, pp. 1589, 1590.

to develop sufficient antitoxin to give the negative Schick reaction and produce marked, if not absolute, protection against diphtheria.

"The development of the immunity is slow. An amount of antitoxin sufficient to prevent the positive Schick reaction develops in the different children in from one to six months after the receiving of the injections. Antitoxin, as heretofore, must continue to be used to produce immediate immunity.

"The duration of the immunity in at least 90 per cent. of the children is for more than six years and probably for the remainder of life. There seems to be no difference in this respect between these and those who develop antitoxin naturally.

"Toxin-antitoxin injections should not be given within two weeks after an injection of antitoxin; otherwise the toxin is slightly overneutralized and the resulting development of antitoxin is lessened.

"Mixtures made from old toxin and antitoxin are fairly stable and may be used for a period of one year. Even such preparations are at their best when first sent out, as the mixtures slowly tend to become at first neutralized and then slightly antitoxic. This change gradually lessens the immunizing power of the toxin. The toxin-antitoxin should be kept cool and in a dark place; it is best to use the mixtures within three months after their final preparation.

"A toxin-antitoxin mixture of stabilized materials which is safe when it leaves the laboratory cannot become more toxic on being kept. No serious effects have ever resulted from the injections given to the tens of thousands of the New York children since we began our work, seven years ago.

"The Schick test is an extremely reliable means of separating those individuals who have antitoxic immunity from those that have none. Although a simple test, it must be carried out with extreme care. The toxin must be retained intracutaneously, and the toxin must be neither 25 per cent. more nor less than the desired amount. It is extremely important to choose glass of suitable chemical composition for the containers in which the toxin is to be placed, as otherwise rapid deterioration may take place.

"The preliminary Schick test is usually omitted in children under three years of age. This is for two reasons: 1, Two-thirds of these children require the toxin-antitoxin injections anyway. 2, We are not certain whether those that do give the negative reaction are immune because of an unusual persistence of the antitoxin given them by their mothers, or because of the active development of antitoxin in their own bodies. After this age the test is desirable, but it is often omitted.

"Thus, in practical school work, the first Schick test is frequently omitted in children up to the age of six because it is easier to inject the children at once rather than to delay for the test. At this age the percentage of children requiring immunization is still high, and the annoyance from the injections is slight. The omission of the preliminary Schick test facilitates the introduction of the immunizing injections in the schools. Above the age of six years the preliminary Schick test should be made whenever practicable.

"No child should be pronounced immune from diphtheria because of having received three immunizing injections of toxin-antitoxin. A negative Schick test is absolutely necessary before one can properly make such a statement or issue a certificate.

"The use of the control protein test made with the heated toxin is advisable at all ages when a careful separation of the pseudonegative reaction from the combined positive reaction is important. As with the Schick test, it is frequently omitted because of local conditions. The older the child, the more likely it is to be immune and to give a confusing protein reaction. In children under five years of age the protein reaction seldom confuses the picture if the Schick tests are read as late as on the fourth day; between five and seven years the control does not help greatly in more than 5 per cent. In older children and adults not only does the control protein test help us to decide more correctly in about 10 per cent. of doubtful reactions; but when it is marked it also indicates with some probability those persons who are likely to have the marked local and constitutional reactions from the toxin-antitoxin injections.

"The toxin-antitoxin injections are inadvisable before the age of six months. During this time most of the infants retain the antitoxin received from their mothers. Up to the age of three months immunizing injections are usually ineffective, as the infant tissues do not respond sufficiently during this period to the toxin-antitoxin to produce antitoxin. Under usual conditions it is probably safe to wait until the infant is nine months old and then to give the injections at the first suitable occasion. During the first three years there is almost no annoyance from the injections. As the child grows older the danger from diphtheria gradually lessens, and the percentage of those developing annoying local and constitutional reactions slowly increases.

"The immunization of school children in acting to prevent their contracting diphtheria also lessens the exposure to infection of the younger children of preschool age in their families.

"There appears to be no difference in the degree of immunity between those indi-

viduals who have developed antitoxin from natural causes and those who did so because of the stimulus of the toxin-antitoxin injections.

"Institutions in which the children have been given the immunizing injections have been remarkably free from diphtheria.

"The school children who have been injected have had one-fourth as many cases as the untreated children, and these cases have been of less severity."

**Pathology.**—Following an invasion of the mucous membrane by the specific bacillus, a pseudomembrane is thrown out which is firmly adherent to the underlying mucosa. The false membrane may be thin and grayish in color, or thick and yellow. It is the result of exudation into the mucosa, ulceration, and necrosis. The mass thus formed is composed chiefly of fibrin, in the meshes of which are entangled polynuclear leukocytes, desquamated epithelium, and bacteria. The fibrin may be deposited in fairly definite layers. Ulceration and small hemorrhages occur in the subjacent tissue, which is very edematous, and detachment of the membrane may leave a raw, bleeding surface. When the separation occurs naturally, the loosening process is one of autolysis, and large defects in the tissue are healed by granulation. New epithelium is generally flat, and cicatricial contractures are common. The Klebs-Löffler bacilli present in the exudate during the acute stage are usually associated with other organisms, such as streptococci and staphylococci, which determine to some degree the appearance of the membrane.

Any of the mucous surfaces may be involved. The process may involve the nasal cavities, the lips, the mouth, the conjunctiva, tonsils, pharynx, trachea and bronchi, and rarely the esophagus. The involvement of the trachea, bronchi, and esophagus in a case observed by the writer was proved at autopsy. The rectum and vagina have also been the seat of the disease.

**Incubation.**—The period of incubation is variable. It may be but a day or two, or it may be a week. According to estimate, 1 per cent. of school children carry the bacilli in their throats in a viable form, and yet by no means 1 per cent. of the children develop the disease.

**Symptoms.**—One of the most important features of diphtheria, in the great majority of cases, is the slow and gradual onset. At first the child may complain of being tired or sleepy and of loss of appetite. Symptoms referable to the throat may appear, but pain is not necessarily present. The breath becomes offensive. The physician is sent for on the first, second, third, or some later day, depending upon the intelligence of the parents or nurse or upon their confidence in themselves to care for what, at the time, appears to be a simple condition. The child, not willing to go to bed, is looked upon by the uneducated eye as being not at all sick. By the time the case is seen by a physician much valuable time may have been lost.

The earlier antitoxin is used, the more certain the recovery. A delay of forty-eight or even twenty-four hours may mean a fatal issue.

Not every case has so gradual an onset.

**Illustrative Cases.**—In the pre-antitoxin period, late in the eighties, an asylum patient died eighteen hours after the appearance of the first symptom.

In March, 1910, a father came leading by the hand two children, aged three and six years. Both had been ill about three days with fever and some difficulty in swallowing. They were supposed to have tonsillitis and had not seemed at all ill to the father.

A glance showed that they were very ill. On further examination the throats of both were found filled with membrane. They were at once sent to the Willard Parker Hospital and given large doses of antitoxin. One child died in twelve hours and the other in twenty-eight hours.

*Localization of the Membrane.*—The usual site of the membrane is on the tonsils and the pillars. The pharynx is more rarely involved, and when involved, has usually become affected through extension of the primary lesion.

*Temperature.*—The temperature, unfortunately, is rarely high early in the case. It seldom rises above 102° F. The lower temperature and gradual onset are accountable for many deaths, the physician being called late in the disease.

*The Lymph-glands.*—Swelling of the lymphatic glands at the angle of the jaw is an early symptom in about 30 per cent. of the cases.

*Diagnosis.*—Visible membrane should always be looked upon as diphtheric, and treated accordingly with antitoxin. Any physician who has looked into thousands of throats, will feel sure that the man is yet to be born who can safely affirm after inspection alone, that a given membrane is not due to the Klebs-Löffler bacillus. There is *no invariable manifestation, no reliable characteristic* of pseudomembrane due to the Klebs-Löffler bacillus.

Antitoxin should be given in any suspected case, and then a culture should be taken. Following out this practice we often give antitoxin to children who are later found not to have diphtheria, as proved by repeated cultures. Never have we regretted this practice.

*Differential Diagnosis.*—Both the streptococcus and staphylococcus may produce a membrane identical in appearance with that produced by the Klebs-Löffler bacillus, and the disease may be differentiated only through cultural examination.

*Tonsillitis.*—In tonsillitis the temperature is high—103° to 105° F. The child is usually much prostrated, and appears very ill. The physician accordingly is called much earlier to the patient ill with tonsillitis than to the one ill with diphtheria.

In tonsillitis the tonsils are more apt to be swollen and enlarged, the exudation appearing in the form of white dots which stud the surface. Care must be exercised, however, in cases which appear to be those of frank tonsillitis. The points of exudation may coalesce and in a day or two may produce a distinct membrane firmly organized. The only safe practice is to make a culture in every case showing visible exudation, whether this is on the tonsils or elsewhere.

*Illustrative Case.*—A mother developed fever and sore throat. The left tonsil was clear. On the right tonsil there were three or four yellowish-white points of exudation. The condition was pronounced tonsillitis by the physician in attendance, and she was not visited further. In four days the doctor was again sent for, and found she had diphtheria with extensive membrane on both tonsils. The mother passed through a desperate illness and recovered completely in six months. In addition to a myocarditis she developed diphtheric paralysis of both lower extremities. Two of her three boys developed the disease and recovered without inconvenience following the early and free use of antitoxin.

Many other instances of the atypical onset of diphtheria might be recited reinforcing the view that one should never look lightly upon a throat showing exudation on its mucous membrane.

**Prognosis.**—A favorable prognosis in a given case depends largely upon two factors: An early diagnosis and a knowledge of the use of antitoxin. The natural resistance of the patient is most important, and particularly important is the condition of the throat—whether normal and resistant, or filled with diseased tissue, supplying a favorable culture field for the invading bacilli.

**Complications.**—The complications, are bronchopneumonia, nephritis, endocarditis, otitis, adenitis, and diphtheric paralysis.

**Treatment.**—Owing to our knowledge of the etiology of diphtheria, and as a result of the advent of the specific remedy, *antitoxin*, the disease has lost much of its former terror. Diphtheria is still, however, an important contributor to the death-rate of all large cities. This is due, first, to parents who fail to appreciate the possible dangers that may arise from a sore throat and who neglect to call a physician early in the illness, and, second, to physicians who do not believe in diphtheria antitoxin, who timidly use it in small doses late in the disease, or who wait for positive clinical signs or a report of a culture before using the remedy. Equally as necessary as the realization of the value of antitoxin is the knowledge of how and when to use it and when to repeat its use. In many cases, at the beginning of the disease, when the tonsils alone are involved, it is impossible, without the aid of the laboratory, to differentiate diphtheria from tonsillitis. Case after case was witnessed in the pre-antitoxin period, in which two or three days were required to make a positive clinical diagnosis. In towns in which a bacteriologic examination is possible it is in some instances safe to wait for a report from such an examination. When one is in doubt, a safer rule to follow in those cases in which there is pseudomembrane on the tonsils is to give antitoxin at once. If the case proves to be one of simple tonsillitis, no harm will follow greater than the inconvenience ordinarily attendant upon the administration of horse-serum.

*Illustrative Case.*—During the winter of 1906-07 a girl six years old developed a gray, membranous patch on the left tonsil, of the size of the thumb-nail. There was a temperature of 101° F. The child complained of feeling tired, seemed generally wretched, and had considerable difficulty in swallowing. Three thousand units of antitoxin were immediately given and a culture from the throat was sent to a private laboratory. Next morning the report arrived stating that the Klebs-Löffler bacillus was absent. At this time the membrane had extended and now covered the right tonsil. The 3000 units of antitoxin were repeated, and a second culture was sent to another private laboratory. Again the report was negative for the Klebs-Löffler bacillus, but the culture showed a pure growth of the streptococcus. The following morning the throat began to clear, and in two days was normal. Clinically this case was one of diphtheria. There was no scarlatina, but there was some swelling of the glands at the angle of the jaw. Aside from the improvement, the child showed no symptoms whatever to indicate that antitoxin had been given.

At the present time a much larger initial dose of antitoxin would be given.

**Antitoxin Dosage.**—When there is membrane on the uvula, the pillars of the fauces, the posterior pharyngeal wall, or in the nose, we should never await the report of a culture, but give a full dose of antitoxin at once. Ten thousand units should be given at the first injection. This should be repeated eight to twelve hours later if there is an extension of the membrane or if there is no change in its appearance. If the throat shows a tendency toward improvement, if there is a curling up and loosen-

ing of the edges of the membrane, or if it has taken on the granular appearance peculiar to diphtheric membrane after the use of antitoxin, we may safely wait twelve hours longer—twenty-four hours in all—before deciding whether a repetition of the original dose or the administration of a smaller one is required. If the case is seen on the third day or after, 10,000 units should be the initial dose and may be repeated as suggested above. In the nasal cases a diminution in discharge, a lessening of the breath fetor, a reduction in the glandular swelling, and a fall in the temperature—all are indications of improvement, but the physician should not rest unless the constitutional improvement and the clearing-up process are rapid and complete. When the case shows no sign of improvement, more antitoxin should be given.

Intravenous, or at least intramuscular, injections are advisable for urgent cases because of the more direct absorption thus secured.

A child ill with diphtheria must be looked upon as poisoned. Antitoxin is the antidote, and every case must receive enough of the antidote to neutralize the poison.

*Means of Injection.*—There are several antitoxin syringes on the market, any one of which may be used if it will admit of repeated boiling, for in every instance the syringe should be boiled before using. The "Record" antitoxin syringe satisfactorily fulfils these requirements. Some of the regular producers of antitoxin furnish it in a container with an appliance for subcutaneous injection. The advantages possessed by this combination are its convenience and its safety, for as the instrument has to be used but once, the danger of infection by means of a syringe which is used repeatedly is thus avoided.

*Site of Injection.*—The skin over the abdomen between the umbilicus and the anterior spine of the ilium is doubtless the most convenient site for the injection. The skin is very loosely attached at this point and the serum passes freely under it, requiring very little force and producing no laceration of the tissues or soreness of the parts sufficient to interfere with the child's customary position in bed. If the buttocks, favorite sites for the injection, are selected, the needle should be inserted well upon one side, so as not to interfere with the resting posture of the child.

Before injection, the skin should be thoroughly scrubbed with green soap and washed with alcohol. Upon the withdrawal of the needle the skin should again be washed with alcohol, and a piece of zinc oxid plaster, 1 inch square, applied over the site of the injection. Under these precautions regarding cleanliness there has never been, in our experience, a suggestion of a local infection.

*Late Injection.*—Antitoxin should always be given in diphtheria, no matter how late in the disease the case may first be seen. In one case first seen by the senior author on the sixth day, 11,000 units were given. The child recovered. In a similar case one would now give 20,000 units. In another case of laryngeal diphtheria in a boy five years of age who was first seen on the fifth day 10,000 units were given, with prompt recovery. In a similar case 20,000 units as the initial dose would now be given and repeated if necessary. Even when the antitoxin has been given as late as the eighth day, recovery apparently due entirely to the serum has

been witnessed. In order to be signally effective, however, the serum should be given not later than the third day. The later it is given, the greater the amount required, and the greater the need of repeating the injection.

*Immunization and Quarantine.*—When a member of a family becomes ill with diphtheria, the suggestions for quarantine (p. 707) should be carefully followed. In every case of diphtheria other children of the family should be immunized directly with antitoxin. Less than 1000 units should never be given for this purpose, regardless of the age of the child. Cultures should be taken from the throats of children and adults alike. If the Klebs-Löffler bacillus is found, the carrier must be isolated and treated as diphtheric so far as quarantine is concerned.

Two children were observed who developed the disease after immunizing doses of antitoxin. A child nine months of age was given 3000 units and developed diphtheria four days afterward. This patient recovered after a second injection of 3000 units. A boy four years of age was given 1000 units for immunization. He developed diphtheria in thirty-six hours, which was controlled by the injection of 3000 units. The throat was clear in forty-eight hours after the second injection.

*Antitoxin Idiosyncrasy.*—In 20 per cent. of the writer's cases urticaria followed the use of antitoxin. The earliest appearance of the eruption was on the fifth day following the injection; its latest appearance, on the twenty-first day. The urticaria apparently differs in no respect from that due to other causes, and the treatment should be the same. Among local applications, a 1 per cent. solution of carbolic acid or a lead and opium wash relieves the itching better than do other measures. For internal administration salicylate of soda answers better than any other form of medication. To a child five years old 3 grains well diluted may be given every two hours until five doses have been taken, and this treatment may be repeated every day until the rash disappears.

The hypodermic administration of 3 minims of 1:1000 adrenalin solution will produce immediate subsidence of the urticaria and afford temporary relief.

Exceptionally in horse-serum-sensitive subjects severe serum sickness with joint manifestations follows the use of antitoxin. In view of the occasional occurrence of sudden severe anaphylaxis following antitoxin injection an initial dose of a minute amount subcutaneously should regularly precede the therapeutic dose of antitoxin whenever the patient is not known to be free from horse-serum sensitivity.

*Remedial Measures Other Than Antitoxin.*—Of the many remedies which have been advocated and used from time to time in the treatment of diphtheria, practically none remains in use at the present time. During the pre-antitoxin period the writer had abundant opportunity in 103 cases at the New York Infant Asylum, to test the value of drugs, inhalations, vaporizing treatment, local applications, gargles, and sprays. In an article relating to this epidemic of diphtheria which he wrote several years ago is the following statement: "The death-rate in the institution from diphtheria was large—about 60 per cent. mortality. In so far as the methods of treatment were concerned, all were equally valueless. The mild and some moderately severe cases recovered under good general management. The severe cases died regardless of treat-

ment." In other words, there was no method or scheme of treatment used at that time that was of any signal value. Happily, at the present time, all the old methods are forgotten. They are not needed. Antitoxin is a specific. The use of sprays and gargles and applications is of value as a means of cleanliness only. For this purpose the *throat irrigation* (p. 321) answers better than any other means. Forceful irrigation of the nose should not be employed. In such cases the danger of forcing infected material into the eustachian tube, with resulting secondary otitis, is real. To small children, if the breathing is interfered with because of membrane or tenacious secretions in the nose, a few drops of liquid petrolatum instilled every hour will give as much relief as can be furnished by any other local measure.

*Sick-room Régime.*—In the management of diphtheria the same sick-room régime should be enforced as in other serious diseases. The temperature of the room should never be above 70° F., and at all seasons of the year there should always be a free communication with the outer air by means of an open window. The child should wear the customary night-clothes, and the bed-clothes should be of the same weight as those used in health.

*Nourishment.*—The nutrition of the patient is most important. As a rule, food is poorly taken because of the pain caused by swallowing. Inasmuch as but a few ounces may be taken at one time, the nourishment may well be given in as concentrated a form as possible. Milk should be given as the chief article of diet, with the addition of lime-water or bicarbonate of soda. If the taste of milk is disagreeable it may be mixed with equal parts of a thick gruel and well salted. Animal broths contain so little nutriment that their use is ill advised. The milk, plain or diluted, will often best be taken if given cold or cool, even to children under one year of age. Fluid will usually also be taken from a spoon or cup better than from a bottle, because of the discomfort produced by drawing on the nipple. When sufficient nourishment is not swallowed, gavage (p. 853) or rectal alimentation assists temporarily in maintaining nutrition.

*The Temperature.*—This is rarely high enough to require the use of any means for its reduction. In case of high fever the sponge-bath or cool pack (p. 841) will answer the requirements.

*Heart Stimulants.*—When the heart action becomes weak, irregular, or intermittent, stimulation will be necessary. For this purpose three drugs are of signal value—strychnin, digitalis, and alcohol.

**Laryngeal diphtheria** may develop coincidently with a tonsillar or faucial diphtheria. The laryngeal inflammation may develop secondarily after a day or two of illness, or it may be the first manifestation of the infection. When a child ill with faucial or tonsillar diphtheria develops a hoarse or croupy voice, with or without impeded respiration, almost invariably the larynx has become involved.

*Differential Diagnosis.*—When, in the event of a hoarse, croupy voice with obstruction as the manifestation of illness, no membrane is visible, it is by no means easy to determine whether the case is one of membranous laryngitis or acute catarrhal laryngitis. The following suggestions have aided not a little in arriving at a right conclusion:

*Diphtheric membranous croup.**Catarrhal croup.*

Gradual onset.

Obstruction persistent, with gradually increasing severity.

Obstruction both to inspiration and expiration.

Little or no response to emetics or inhalations.

No response to sedatives.

Obstruction intermittent.

Sudden onset.

Obstruction to inspiration, but little to expiration.

Response to emetics and inhalations and to sedatives.

Contrary to the usual rule, the onset of catarrhal laryngitis may be gradual, while that of diphtheria may be sudden. In the consideration of a great many cases, however, the points of differentiation are of sufficient value to warrant the attention which has been given them. A particularly valuable sign of diphtheric involvement is the obstruction to expiration as well as inspiration. In catarrhal croup there is obstruction to inspiration only.

*Treatment.*—A safe rule to follow, in view of the urgent demand for early injections of antitoxin, is the same as in other forms of diphtheria, *i. e.*, when in doubt, inject 20,000 units. From the gradual cessation of the laryngeal symptoms it is fairly safe to assume that the child is doing well, although the breathing may not be entirely free for forty-eight or seventy-two hours after the first injection. In cases which require intubation 20,000 units should be given for the first injection and repeated the following day. According to our observation, severe laryngeal cases require from 20,000 to 40,000 units, even when antitoxin is used early, by which we understand on the second or third day of the disease. The earlier the injection, as has been stated, the less frequent will be the necessity for its repetition.

**Nasal Diphtheria.**—There are two distinct types of nasal diphtheria—the *acute* and the *chronic*.

The *acute* cases resemble in all respects those of diphtheria as it occurs in the throat or larynx with the accompanying clinical manifestations of illness and prostration. There may be membrane elsewhere, and in many of the cases involving the throat and larynx the nares are also involved. At autopsies, before the advent of antitoxin, the nasal passages were often found plugged throughout their entire extent, the membrane being continuous from the anterior nares to beyond the first bronchial bifurcation.

In what may be looked upon as the strictly nasal cases the mucous membrane of one or both nasal passages only is involved.

*Symptomatology.*—A symptom pointing strongly to a Klebs-Löffler infection of the mucous membrane of the nasal passages is a persistent excoriating mucous discharge, with or without a tinge of blood. The fever, prostration, and other evidence of the infection may be as severe as when the membrane is elsewhere located.

*Diagnosis.*—The diagnosis is made by the appearance of the persistent excoriating discharge, by the discovery of false membrane in the nasal cavities, and by the finding of the Klebs-Löffler bacillus in the nasal discharge.

Exceptionally a foreign body in the nares may give rise to a similar persistent discharge without the presence of the diphtheria organism.

*Treatment.*—The treatment is with antitoxin, as suggested for the tonsillar and faucial cases.

**Persistent Nasal Infection with the Klebs-Löffler Bacillus.**—Persistent nasal infection of a mild type is of much more frequent occurrence than is generally known. These cases are sometimes alluded to by writers under the term “chronic nasal diphtheria.”

*Symptoms.*—The child has a persistent sanious discharge from one or both nostrils, but shows no sign of illness other than that occasioned by the persistent rhinitis. Since there are no systemic effects, these are not cases of diphtheria in the accepted sense of the term. Ulcerations are occasionally produced, and there may be destruction of membrane, cartilage, and bone.

*Illustrative Cases.*—*Case 1.*—A girl of eight years of age had a nasal discharge associated with considerable obstruction. The child had been ill for about one week, and had been treated for grip by home remedies. There had been slight fever and little or no prostration, but a serous nasal discharge which was at times bloody. There had been one or two severe nasal hemorrhages. An examination of the nasal cavities disclosed that both were filled with membrane, pus, and blood. Nasal diphtheria was at once suspected, and a culture was made which was negative. During the following three days six cultures in all were made and examined by three different bacteriologists in three laboratories, and all reports were negative for the Klebs-Löffler bacillus. The membrane was removed on two occasions, and there were three fairly severe nasal hemorrhages while we were trying to determine the nature of the infection. Various local measures were employed without in any way influencing the process. After the case had been observed one week, during which time the child remained free from constitutional disturbance of any nature, 5000 units of antitoxin were given. In twenty-four hours the nose was clear and only a considerable erosion on the septum remained, which promised to give trouble because of its depth and tendency to bleed. This area was cauterized and healed promptly, and the child was then well.

Interesting is this case in view of the cultural absence of the Klebs-Löffler bacillus, and the prompt response to antitoxin, which indicated beyond doubt that the case was one of diphtheria.

*Case 2.*—A strong, robust boy, twelve years old, from a New York suburb, came for examination solely on account of inability to breathe through his nose and a night cough which was quite severe. Examination showed the nose to be filled with crusts, pus, and dried blood. Upon removing the obstruction a bleeding surface was left on both sides, and a perforation of the septum, the size of a dime, was found posteriorly. A culture was taken and showed a pure growth of the Klebs-Löffler bacillus. Five thousand units of antitoxin were given. The condition immediately improved. Within four days the nose was free from the Klebs-Löffler bacillus. This condition had existed for at least a year.

*Case 3.*—A girl four years of age became ill with fever, which persisted for thirty-six hours, when the attending physician noticed a swelling and edematous condition of the soft palate. On seeing the case forty-eight hours after the onset the writer found the swelling and edema still present, with considerable post-nasal discharge. At no time was membrane visible. A culture was taken which proved negative. Five thousand units of antitoxin were given, and the child made a prompt recovery in about forty-eight hours. While there is no direct proof that the child had diphtheria, the prompt recovery after antitoxin suggests this condition. The absence of cultural proof, in view of experience in the first case recounted, does not signify that the infection did not exist.

*Case 4.*—A mother presented for treatment 2 children aged two and four years, both of whom had had a chronic cold in the head for six weeks. There was a persistent nasal discharge from both nostrils in each patient, serous in character, requiring several handkerchiefs daily. The children were generally well and happy. A culture showed Klebs-Löffler bacilli in both. Five thousand units of antitoxin given to each child cured the condition.

Much remains to be learned regarding the Klebs-Löffler bacillus and its action upon the individual. The effects of this organism may be entirely local. Every year in hospital work we see many of these

cases. In private they are less frequently encountered. On the other hand, what is apparently the same organism, with the same morphologic characteristics, may produce not only local effects but the most profound systemic toxemia and death.

In the cases with local manifestations, are we dealing with the Klebs-Löffler bacillus in an attenuated form, or is the infection of a different nature and due to another organism of the same family? Although it would seem readily possible for the patients showing only local manifestations to transmit the disease to others with resulting systemic effects, the writer has never known of such an occurrence.

*Treatment.*—In these cases usually one dose of 5000 units of antitoxin is sufficient. If the process is not controlled, this dose should be repeated.

*Intubation.*—To the genius of the late Dr. Joseph O'Dwyer, of New York, is due the perfecting of this operation. It will forever stand as a monument to the inestimable service which he rendered to mankind. The O'Dwyer intubation set furnishes us with the necessary instruments for the operation. Various modifications of the tubes, the introducer and the retractor have been attempted from time to time by others, but the original perfected design of O'Dwyer has yet to be improved upon.

Intubation of the larynx may be required in case of a retropharyngeal abscess situated low on the posterior pharyngeal wall, edema of the larynx, or acute laryngitis. The greatest usefulness of the operation, however—that for which it was designed—is to relieve the stenosis of laryngeal diphtheria. Before attempting to introduce a tube into the larynx of the living subject the physician should familiarize himself with the operation on the cadaver. In no other way can the procedure safely be learned. Attempts at intubations by the unskilled on the living subject can result only in laceration and other gross injuries to the parts.

*Indications for Intubation in Diphtheria.*—When to intubate is a question puzzling alike to students and to many physicians. It has been variously answered, and many attempts have been made to formulate a series of clinical manifestations the presence of which would render the operation necessary. Thus, it has been said to be indicated when there is a pronounced recession of the suprasternal and infrasternal regions, and when, as a result the stenosis, air enters the bases of the lungs but feebly or not at all. It may safely be said that intubation is rarely done too early, but it is very apt to be done too late—not too late in a great majority of instances to be of some service to the patient, but too late to be of the greatest possible service. The best rule regarding intubation in laryngeal diphtheria is to intubate when one sees that the child is wasting vitality in his efforts to carry on respiration. Intubation should not be postponed until he becomes exhausted in the struggle for air. Diphtheria is a disease in which every possible strength-unit must be preserved. Energy wasted in supplying air is an unnecessary waste.

*Operation.*—For the operation of intubation the patient should be wrapped from his shoulders to his feet in a sheet securely pinned from top to bottom. The older and stronger the child, the more this is necessary. The patient is held on the lap of the nurse, who passes her right

hand around the child's body. The child's body rests on the nurse's right shoulder, firmly held in position by her left hand. If the child be large and strong, a third person may be required to hold the head, with the patient recumbent. After the gag is in position, the operator, holding the introducer in his right hand, locates the glottis with the forefinger of the left and using it as a guide directs the tip of the tube into the larynx. He must be certain that the tip is properly placed before exerting pressure to put the tube into position. This can readily be appreciated by one who has practised on the cadaver. When the tip of the tube positively is engaged in the glottis, gentle pressure will put it into final position. Force should never be used, even when the tube is started right, for the child may require a smaller tube than his age indicates. This is rather unusual, however, as are the cases which require larger tubes than the age calls for. When the tube is easily coughed up, it is essential to introduce the next larger size. With the tube in position, the obturator is quickly removed. One should never trust to pressure on the shank of the introducer to disengage the obturator, but keep the guiding index-finger of the left hand on the expanded head of the tube in order to insure its remaining in position during the extraction of the obturator.

*Results of Intubation.*—After the operation the child who has previously been struggling will take a deep inspiration and cough. One of the most welcome sounds to the operator is the sharp rattle produced by the passage of air through the mucus which has been forced into the tube. This tells him that the tube is in position and that speedy relief of the stenosis may be expected. The intubated child will usually cough vigorously for several minutes, and in so doing may bring up a quantity of mucus and shreds of membrane. One is often astonished at the large pieces of membrane and the quantity of thick mucus that can pass through the comparatively small lumen of the tube.

In a few cases the presence of the tube in the larynx has caused such a persistent cough that a sedative was required to control it. Small doses of bromid of soda—4 grains every half-hour for two or three hours, for a child four years of age—usually answer the purpose.

The thread, looped and knotted, attached to the tube, should be long enough to extend 4 or 5 inches beyond the lips. In case relief to the stenosis is not immediately perceptible after the operation, or if the breathing is made more difficult, one may be sure either that the tube is not in position or, if in position, that it is plugged with membrane, or that membrane may have become disengaged and is pushed downward ahead of the tube. A tube in the esophagus, where, in hospital service, it is often placed by interns, may exert sufficient pressure upon the posterior portion of the larynx effectually to impede respiration.

*Illustrative Case.*—It became necessary to intubate a boy two years of age who was suffering from moderate stenosis due to diphtheria. The tube was easily introduced, but its introduction was followed by entire cessation of respiration. The tube was immediately extracted by means of the attached thread and was found to be plugged with membrane requiring considerable pressure with a wooden toothpick to dislodge it. The stenosis evidently was somewhat relieved as the result of dilating the parts and a removal of a portion of the membrane, but not sufficiently to insure permanent relief to the patient. The tube was again introduced, followed by a complete relief of the stenosis.

*Displacement of the Membrane.*—When membrane is dislodged and pushed ahead of the tube, it will usually be expelled by coughing after the extraction of the tube.

*Illustrative Case.*—A case of this nature, following the withdrawal of the obturator, occurred in a child six years of age, whose breathing, before difficult, became impossible. The child struggled violently, became much excited, and with one hand free, knocked the gag from the mouth. Upon efforts to extract the tube the string broke, and while the gag was being introduced in order to use the extractor, the child's struggles and attempts at coughing dislodged both the tube and a large amount of membrane, one piece of which, inclosing the tube, came out as a perfect cast of the larynx and upper trachea. The relief was immediate. Reintubation was not attempted, nor was it later necessary. The child had been given 5000 units of antitoxin twenty-four hours before, which helps to explain the dislodgment of the membrane.

*Removal of the Tube.*—When the patient is progressing satisfactorily, the question arises: How soon may the tube be removed? Rarely should this be done before the fourth day after intubation. When the tube is taken out on the second or third day, for cleansing or other purposes, it must usually be replaced.

*Necessity for Intubation.*—With the introduction of antitoxin, the necessity for intubation has become less frequent. The free use of antitoxin—10,000 to 30,000 units as an initial dose—given with the first sign of obstruction, and repeated at eight-hour intervals until two, three, or more doses have been given, will render intubation a still rarer necessity. One does not feel safe in these cases until 15,000 or 20,000 units have been given. Fortunately, in laryngeal obstruction due to diphtheria the stenosis is usually of gradually increasing severity, so that by the early use of antitoxin many cases are relieved before the necessity for operation arises.

*Suction in Laryngeal Diphtheria.*—In view of the high mortality ranging from 25 to 40 per cent. in intubated hospital cases suction aided by direct laryngoscopy has recently been used at the Willard Parker Hospital by Gover and Hardman<sup>1</sup> with signal success. This method promises to lessen the number of cases requiring intubation and tracheotomy, but should not be attempted by one unfamiliar with laryngoscopy, intubation, and tracheotomy.

### SCARLET FEVER (SCARLATINA)

Scarlet fever has been clearly recognized for many centuries, although its early history is exceedingly obscure. The disease has always been most prevalent in civilized portions of the world, has shown remarkable differences in the severity of its separate outbreaks, and in almost all instances notably refrained from attacking a certain proportion of exposed individuals, in this respect contrasting sharply with measles, which exhibits no such selectiveness.

Jurgensen reported an epidemic which in the years 1873 to 1875 ravaged the Farøe Islands, where for at least half a century the inhabitants had not been exposed to the disease and where the geographic conditions rendered observations on its course unusually easy. Here the discovery was made that, from a population comprising all ages and certainly not protected against scarlatina by a previous attack, only

<sup>1</sup> Arch. of Pediat., March, 1923.

38.3 per cent. suffered from the epidemic, whereas a similar study of measles in the same locality showed that 99 per cent. of the population unprotected by previous infection were attacked. It was furthermore observed that the susceptibility to scarlet fever was about seven times greater in persons under twenty than in those over forty.

The records of certain European epidemics exhibit a mortality as high as 30 per cent., contrasting with a rate as low as 3 per cent. for the same place at another period. In New York State scarlet fever easily ranks among the dozen most prominent causes of death, usually causing a comparative mortality of five, to four of measles and six of typhoid.

Recent studies of the disease have been devoted extensively to a search for the specific cause, our ignorance regarding which has been in the past the most serious obstacle in the management of cases.

A résumé of the more important recent contributions dealing with the specific aspects of the disease has been presented by Ruth Crabtree<sup>1</sup> and to this we have resorted for numerous facts here cited.

**Etiology.**—The specific etiologic factor in scarlet fever was early recognized as present in the throat and in discharges from complicating otitis and other suppurative inflammations, and the constant association of the streptococcus with this disease led to the belief that this organism was the cause. Moser,<sup>2</sup> as early as 1902, contended that the streptococcus found in patients was of a specific type. This belief, however, gave way to the view quite generally held that the streptococcus found in scarlet fever cases was merely a secondary invader. It was not until after the introduction of methods devised by Dochez and Avery<sup>3</sup> based on biologic immunity reactions that it was established that the strains from throats of scarlet fever patients were specific. Attempts to produce the disease experimentally culminated late in 1923, with the inoculation of volunteers by the Dicks,<sup>4</sup> and the production of a disease practically identical with scarlet fever in guinea-pigs by Dochez and Sherman.<sup>5</sup>

**Transmission.**—The infection is usually transmitted through association of the diseased with the unprotected. Conveyance of the infection by an intermediary probably is of rare occurrence. Milk may be a means of conveyance.

It has long been appreciated that scarlet fever is among the less contagious of the contagious diseases. Repeatedly when a case has been seen to develop in a hospital ward, there has been no occurrence of the disease in other children confined to bed and so kept from immediate contact with the scarlet fever patient.

The most contagious period is probably during the first three or four days of the illness. The danger of transmission during the period of desquamation is much less than is generally believed. Although, until more concerning the nature of the infecting agent is known it is not wise to make definite statements respecting the period of communicability, observation of a great many cases in institutions and in private work leads to the belief that the desquamation seldom, if ever, transmits the

<sup>1</sup> Archives of Pediatrics, xli, 6, June, 1924.

<sup>2</sup> Jahrbuch f. Kinderh., 57, 1903.

<sup>3</sup> Jour. Exp. Med., 30, 179, September, 1919.

<sup>4</sup> Jour. Amer. Med. Assoc., 81, 1166, October 6, 1923.

<sup>5</sup> Proc. Soc. Exp. Biol. and Med., 21, 184, 1923.

disease. Even before the specific etiology of the infection was established many authors were inclined to place less emphasis upon the possible contagion from cutaneous scales and more upon the infective character of the nasal and aural discharges.

Evidence is at hand showing that books, clothing, flowers, and food-stuffs are means of conveyance from the diseased to the unprotected. From personal observation, we have never known of a case having been contracted in any of these ways. A great many cases of scarlet fever are seen, however, which, ordinarily, would have passed undiagnosed if the patient had not been suspected because of known exposure. Cases are frequent in which a positive immediate diagnosis is quite impossible.

*Illustrative Case.*—During the visitation of scarlet fever to a family, four children were attacked. Dr. S. Finley Bell had treated the two other members of the family at Englewood, a suburb of New York. A trained nurse caring for the children contracted the disease and died. Later, a girl six years old died with the disease. On a visit to one of the children who had been sent to New York City and later developed the disease, a member of the family called attention to the arms of the laundress, which were slightly reddened. It was Monday morning and she was washing. She had no temperature, a normal throat, no rash except upon the arms, and felt well and was annoyed that she should be disturbed in her work. The redness of the arms disappeared after the completion of the washing, and nothing further was discovered until two weeks later, when she was found to be desquamating profusely on the hands and feet and slightly over the body generally. She was sent to the Willard Parker Hospital, where she required two weeks to complete the desquamation. Here was a case in which a most careful search failed to reveal any conclusive evidence of scarlet fever, and yet the woman was proved to have had the disease at the time of examination.

There is strong probability that many of the cases of obscure origin are contracted by exposure to such atypical cases, rather than through infected milk, books, articles of clothing, or intermediary human carriers.

**Susceptibility.**—The most susceptible age is from the second to the twelfth year. Cases occurring in children under one year old are rare. The very young appear to possess a distinct immunity.

*Illustrative Case.*—During an epidemic at the New York Infant Asylum at Mt. Vernon, N. Y., a colored boy was found to have the disease in a very active form. The institution was built on the cottage plan and this boy, 28 runabout children, and 4 nursing women orderlies with their 4 nurslings occupied the ward on a second floor in one of the two-story cottages. The institution, comprising 400 children and about 200 women, was crowded.

To break up the ward would have meant that the exposed children, some of whom would probably develop scarlet fever, would be placed with unprotected and unexposed children. It was, therefore, decided to quarantine the ward with its inmates. Every child in this ward developed scarlet fever except the four nurslings, who at the time of the outbreak were under three months of age. Three of the women also escaped. The fourth woman developed the disease and had a moderately severe attack, during which time she nursed her infant, which remained well. It is of interest that so effective was the quarantine that the disease did not spread beyond the ward in which it developed.

Zingher has noted a similarity between the incidence of positive Dick reactions and positive Schick reactions, in that there is a greater apparent susceptibility to scarlet fever in the poorer and more populous districts. With the wider application of the Dick test this knowledge will be greatly supplemented.

It has not been observed that the presence of wounds in any portion of the body renders a person more liable to scarlet fever.

**Second Attacks.**—One attack almost always protects from subsequent attacks.

Only two undoubted instances of a second attack have been personally observed, one of which occurred after an interval of four months in a boy of six years, the child dying on the fifth day of the illness; the other in a girl twelve years of age, whose previous attack was four years earlier. In the girl the second attack ran a typical but uneventful course.

It is interesting to note that an unprotected individual may be repeatedly exposed and only at a late period develop the disease.

Thus, during an intern service in the institution referred to, where the writer cared for 108 cases of scarlet fever, and the epidemic was severe, requiring that many children be seen several times a day, three months of daily and sometimes hourly exposure transpired before he developed unmistakable signs of the disease.

**Specific Skin Reactions.**—In 1918 Schultz and Charlton<sup>1</sup> described their so-called *extinction test*. They found that the injection of normal or convalescent serum intracutaneously at the height of the rash produced blanching of the reddened skin about the site of the injection. It remained for Mair<sup>2</sup> to point out that the blanching power, which was not exhibited by all normal serum, was actually peculiar to serum possessing immune properties.

**The Dick Test.**—By using the filtrate of the cultures used in producing scarlet fever experimentally in man the Dicks<sup>3</sup> were able to develop a specific skin test for immunity, similar to the Schick test for susceptibility to diphtheria. The specificity of the Dick test is now well established by numerous observers, including Williams, Hussey, Banzaf,<sup>4</sup> and Zingher.<sup>5</sup>

As might be expected, sera of individuals giving a negative Dick test is found to cause blanching when employed for the Schultz and Charlton extinction test, and to neutralize the toxin of the filtrates of the specific streptococcus cultures; while sera of persons giving positive Dick reactions is impotent for the production of both these results.

**Incubation.**—The period of incubation is variable. It is rarely less than five days. If an exposed child passes the ninth day in safety, the disease will probably not develop later. One case developed after twelve days' exposure, and one on the fourteenth day following exposure. These observations were made in an institution with adequate quarantine facilities which removed all doubt as to any other source of exposure than the original one. So long a period of incubation, however, is exceedingly rare. Cases reported as developing after a very long incubation—three to four weeks—result from more recent exposure which was not known.

**Symptomatology.**—Nearly all the characteristics of the disease are subject to wide variations. Even the rash, the most constant symptom, may be simulated by sepsis or produced by drugs. Among the diseases of children which we are called upon to treat there is, furthermore, no other which may present itself in such unusual and peculiar ways.

The three symptoms upon which some reliance may be placed are *fever, angina, and the rash*. Any one of these, however, may be absent

<sup>1</sup> *Ztschr. f. Kinderh.*, 17, 328, 1918.

<sup>2</sup> *Lancet*, 2, 1390, December 29, 1923.

<sup>3</sup> *Jour. Amer. Med. Assoc.*, 82, 301, January 26, 1924.

<sup>4</sup> *Proc. Soc. Exp. Biol. and Med.*, 21, February 11, 1924.

<sup>5</sup> *Ibid.*

in the mild cases. In the moderately severe cases the onset is usually abrupt, with fever, angina, prostration, and vomiting, and after twenty-four to forty-eight hours the developing rash, which is usually fairly characteristic. The angina causes a diffuse redness of the mucous membrane of the fauces and tonsils, and on the soft palate above the uvula minute red points become visible which may coalesce, forming diffuse, small, injected areas, and producing a blotched appearance.

There is loss of appetite and always thirst. The child is irritable, and if old enough, complains of headache and muscle soreness. The temperature furnishes a fairly accurate index of the severity of the disease. The mild cases show little fever, while the severe cases almost always exhibit a high temperature. Thus a temperature range from 103° to 105° F. will usually be accompanied by a well-marked rash and prostration, which tell us that the poisoning is severe. When the temperature remains above 103° F., the child is very uncomfortable and complains much of itching.

The eruption remains at its height from two to six days, which may be looked upon as the period of the rash. With a subsidence of the rash the temperature falls gradually to normal.

*Desquamation.*—Coincident with the fading of the rash the desquamation usually begins. It may be delayed, however, from this time until the third or fourth week and may show great irregularity in its duration. In a very few cases the rash has lasted later than the tenth day.

*Illustrative Case.*—During the epidemic mentioned every child in the institution was carefully inspected three times daily. At 5 p. m., the time of the last inspection for the day, a boy of two years had a temperature of 102° F., an unmistakable rash over the left buttock and thigh, and some redness of the throat. There was but little prostration. He was quarantined, and six hours after his isolation the rash faded absolutely, the fever promptly subsiding on the same day. In spite of the suspicion of a mistake in diagnosis, inasmuch as he had been placed in a scarlet fever ward and exposed, we had to keep him there. Greatly to our surprise, on the tenth day free desquamation began.

When uncomplicated, the average case goes on to recovery, with completed desquamation in from two to four weeks.

The shedding of dead epidermis may be most variable in its manifestations. The skin of the hands and feet has been seen to be shed like a glove "en masse," and yet in a case in which the rash was equally well marked no desquamation of any nature was to be observed at any time. There has been desquamation, however, although occasionally very slight, in nearly all scarlet fever cases coming under our observation. The heel and the anterior aspect of the fingers and toes are the sites usually selected when the desquamation is scanty.

*Second Desquamation.*—Only 2 cases of second desquamation were seen.

The first patient was a girl of five years, who completed the first desquamation and was free for six weeks, when the desquamation again occurred on the hands and feet and required three weeks for its completion. In the other case, that of a girl twelve years of age, the second desquamation appeared three weeks after the completion of the first. It involved only the feet and was of two weeks' duration.

The amount of desquamation bears a fairly definite relation to the severity of the rash, except in the anomalous cases.

*Severity.*—The illness may be of the mildest type, and impossible of positive diagnosis, or it may be so severe that the child will live only a few hours.

A fatal case lasted thirty-six hours from the onset of the symptoms. The child was never conscious after the first invasion, and the temperature never below 106° F., nor could it be reduced below this point. The rash was hemorrhagic.

Such cases as these, in which the system is absolutely overpowered by the scarlet fever poison, are extremely rare. The disease, when fatal, is usually so through its complications.

*Diagnosis.*—The diagnosis in many cases is very easy. In some it is difficult, and in others impossible. Not only are the mild cases difficult of diagnosis but also the very severe cases. In malignant cases the patient may die before the development of characteristic signs, or the signs may be so masked by the severity of the infection as to render diagnosis impossible.

The diagnostic features are the angina, which occasions a diffuse, intense general redness of the throat, the fever, and the diffuse blush of the skin, which in twelve to twenty-four hours develops into a diffuse punctate rash usually appearing first and most characteristically over the lower abdomen, in the groin, on the inner aspect of the thighs, and over the buttocks, and thence extending to, and involving, the entire skin surface.

It has not been the rule that the rash first appears on the neck and chest, as has been claimed by different writers.

The so-called strawberry tongue is of little differential value, for it may occur in many other forms of illness.

*Complications.*—Probably no other disease of infancy or childhood is so fertile in serious complications as scarlet fever. In fact, comparatively few die from the direct effects of the scarlet fever poison. A streptococcus infection of the throat is present in all cases and the throat as a culture field for the streptococcus is the great source of danger in the disease.

*Membranous non-diphtheric angina* complicating scarlet fever has always been of streptococcal origin in our cases. On inspection, the exudation resembles that of true diphtheria and our only means of differentiation is the making of a culture. Such a membrane may involve the nasal passages, but rarely extends to the larynx.

The local infection may be sufficiently severe to cause extreme necrosis.

*Illustrative Cases.*—In one case shortly before the time set for operative removal of a pair of very large tonsils, a boy developed very severe scarlet fever. On his recovery the throat was as free of tonsil tissue as if they had been carefully enucleated.

In a fatal case necrosis of the soft palate occurred, resulting in a perforating ulcer larger than a dime.

*True diphtheria* occurs as a complication in a very small percentage of the cases. Before our knowledge of the Klebs-Löffler bacillus much was heard of diphtheria as complicating scarlet fever, because of the presence on the tonsils of membrane, which we now know to be of streptococcal origin.

*Adenitis.*—From the throat the glands may be infected. The lym-

phatic glands at the angle of the jaw and the retropharyngeal glands are, by reason of their location, the most frequently involved. Suppuration of the glands and abscess are very frequent, and diffuse edematous cellulitis of the neck is an occasional result of such infection.

Cases have been reported in which the pus burrowed into the mediastinum, causing *septic endocarditis* and *empyema*.

*Pericarditis* and *endocarditis* have been very rare complications and, in the cases personally observed, have always been fatal, for the reason that such cases of streptococcal origin are always purulent.

*Myocarditis* of a mild degree is often disclosed at autopsy.

*Lobar pneumonia* is a very unusual complication.

*Bronchopneumonia* is found at autopsy in nearly all the fatal cases. The development of the disease during an attack of scarlet fever is of very grave import.

*Otitis* is a frequent and dangerous complication. If all cases of scarlet fever, the mild, the moderately severe, and severe, are included, otitis will be found in over 10 per cent.

*Albuminuria*.—Early in the average case albumin will be found in the urine if this is repeatedly examined with sufficient care. This condition does not constitute nephritis, however, for albumin in small amounts is found in most diseases of toxic origin in childhood.

*Nephritis*.—Scarlatinal nephritis rarely appears before the third week of the disease. Cases have been personally observed to develop as late as the twelfth week after the onset. The nephritis is of the glomerular type, and more likely to occur after mild infections. The first sign will usually be that of a puffiness under the eyes and about the ankles. The urine becomes scanty and high colored. This complication is referred to again on p. 713.

*Arthritis*.—Joint complication has been present in but 5 per cent. of our cases. The arthritis is the manifestation of a local infection. There may be swelling and redness of two or more of the joints. We have never observed one joint alone to be involved. In some cases pain alone will be present, without either of the above symptoms.

*Illustrative Case*.—A fatal case of pyemic arthritis was seen in consultation with the late Dr. McInerney, of New York. The joints at the knees, ankles, elbows, and wrists suppurated.

**Mortality**.—The mortality varies greatly. Different epidemics give a different mortality. In institution epidemics the mortality is higher than among children in private life. In the New York Infant Asylum, during the service referred to, the mortality in children under six years of age was 20 per cent. In private work the average mortality ranges under 10 per cent. In greater New York the mortality rate within the past ten years has been slightly over 4 per 100,000 of population.

**Quarantine**.—The isolation of those ill with contagious diseases is an absolute necessity for the protection of others. While it is advisable in cases of scarlet fever to remove from the house children who have not had the disease, such removal is often impossible. It then becomes our duty to establish such a quarantine as will be effective in preventing the transmission of the infection. In order to do this, the

child and the attendant must be kept from contact with other members of the family, whether children or adults. If the residence is a complete house, one or two rooms on the top floor should be selected for the patient, the room from which he is removed being carefully cleaned and disinfected. If the family occupy an apartment, an effective isolation is more difficult, but is by no means impossible. In such circumstances the room must be as remote as possible from the other living rooms. It should be prepared for the patient according to the instructions laid down on p. 152. Not only should the attendant not come in direct contact with other members of the family, but there must be no indirect contact through dishes, feeding utensils, clothing, or bed-linen. The dishes, knives, forks, and spoons should be placed in boiling water and in this sent to the kitchen. The clothing, towels, and bed-linen should be placed either in boiling water or in a carbolic solution—1 ounce to 2 gallons of water—before sending them to the laundry. Upon their arrival at the laundry they should be boiled at once. A chair outside the door of the sick-room may be used as a receptacle for the various articles for the patient. These are to be removed only when the person who brought them is at a safe distance.

Two isolating rooms are better than one, and if there is a connecting bath-room, it is much more agreeable to the occupants. If two rooms are devoted to the patient, one is to be used for day and the other for night occupancy, the unoccupied room being freely ventilated after the removal of the child. Observing the above precautions until the child is well, we have in many instances carried through to successful convalescence cases of scarlet fever while other susceptible children have remained in the household during the entire illness without taking the disease.

*Illustrative Case.*—An incident, previously referred to, which well demonstrates the value of proper quarantine, occurred at the New York Infant Asylum, Mt. Vernon, New York, during the senior author's service as intern in that institution. The institution was built on the cottage plan, two wards in a cottage. A colored child, an occupant of one of the upper wards, was discovered to be ill with scarlet fever. There was an extensive rash, considerable swelling of the cervical glands, and the whole aspect of the case was that of this disease at its height. Through the negligence of an orderly the child had probably been ill two or three days before attention was called to him; as a consequence 30 other children of the ward had been exposed. In order to prevent the spread of the disease to the other 400 children, it was decided to quarantine the ward with its children and the 4 attendants. This was done. Twenty-six children and one woman attendant developed the disease. The quarantine, on the plan above suggested, was continued for ten weeks. The 30 or more children on the ground floor of the cottage remained there as before, but no other case developed in the institution. In order to prevent the spread of the contagion there was no personal contact with those outside of the ward, except on the part of the physician who visited them daily, but who always went properly protected. All clothing and bed-linen were boiled before being removed from the ward. The dishes and feeding utensils were likewise boiled before being sent to the general kitchen.

If such isolation is possible in an institution among the careless and more or less ignorant, it certainly should be equally effective among the intelligent, who are most interested in preventing the spread of disease.

When the quarantine is raised, the child should receive a bath of hot water and thorough scrubbing with plenty of soap. A few hours later a bath of bichlorid 1 : 3000 should be given. If the hair is cut short and shampooed with green soap, followed by the bichlorid, the disinfection is more complete.

**Prophylaxis.**—Although convalescent serum has afforded apparently favorable results in preventing the disease in exposed persons, it may be predicted that this method offers little.

The Dicks have succeeded in developing an active immunity by injecting their toxic filtrate into susceptible subjects, and the attempt is being made to develop this method on a considerable scale in procedure analogous to that employed for toxin-antitoxin administration in diphtheria.

A most efficient safeguard is a normal throat. The presence of enlarged tonsils and adenoids doubtless increases susceptibility to the disease, and their presence adds greatly to the dangers.

**Treatment.**—The patient must be kept in bed throughout the entire illness, from four to six weeks from the onset first manifested by sore throat and fever, until the desquamation is completed. We must realize at the outset the possibilities latent in the virulence of the infection and the complications.

The *sick-room* should be as large as it is possible for the family to supply. It is desirable that it be well lighted by two windows which will make free ventilation possible. For the latter purpose, the window-board (p. 26) answers well. There should always be a direct communication with the open air, except when the child is being bathed or the clothing changed. Light and the free circulation of fresh air are absolutely necessary for proper management of a severe case. If possible, two rooms should be used—one for the day, the other for the night. The room which is not occupied should have the windows wide open. When nephritis, endocarditis, or otitis develop, they are the result of the scarlet fever poison or associated infection, and not due to the fact that a window was left open.

**Clothing.**—The child requires no extra jacket or wraps. The customary night-gown, with the light gauze undershirt, and the usual bed-covering, is all that is required.

**Urine Examinations.**—The urine should be examined for albumin every day. It is excellent practice to have in the house a few test-tubes and a bottle of chemically pure nitric acid. When the busy physician has the daily specimen sent to his office or carries it home himself it is sometimes forgotten, misplaced, or lost. During convalescence, when the daily visit is not made, the nurse or some intelligent member of the family may be instructed to make the test and report if trouble is discovered. Because of a lack of these precautions, nephritis may easily be overlooked until puffiness about the eyes and edema of the lower extremities are discovered by the attendant after albumin has been present in the urine for several days.

**Diet.**—For the bottle fed during the acute febrile stage the food strength should be reduced one-half by the use of boiled water. If the child is getting 8 ounces of a milk mixture, 4 ounces of this mixture should be given with 4 ounces of water. For older children the diet should be considerably restricted, not only during the acute stage, but during the entire course of the disease. During the acute febrile stage diluted milk, gruels, and orange-juice should constitute the diet. To a child from two to four years of age, 5 ounces of milk with 5 ounces of barley gruel No. 2 (see Formulary, page 94) may be given at four-hour intervals, four or

five feedings in twenty-four hours constituting an acceptable diet. Variations may be made in the gruels used. Wheat, rice, and Granum may all be brought into use, made as suggested in the formulary and given with equal parts of milk. It is always well to provide for some variety in the food, in order that the child may not tire of it. The juice of one-half an orange may be given twice daily, three hours after the milk and the gruel feeding. For the sake of variety a glass of whey or kumyss, or a glass of skimmed milk containing  $\frac{1}{2}$  ounce of lime-water may occasionally be allowed. Toasted bread, zwieback, or plain crackers, dry or in diluted milk, may also be given occasionally.

*Milk Diet.*—The extensive milk diet in the management of scarlet fever, about which we have all heard and still hear a great deal, has not been so successful as has the foregoing. The exclusive milk diet is apt to produce constipation, intestinal indigestion, coated tongue and loss of appetite; in fact, the child “grows stale” on milk, which should properly be our dietetic mainstay during the weeks that are to follow. During the post-febrile period slight additions should be made to the diet by the use of farina, hominy, wheatena, and the lighter cereals, prepared as porridge with a sprinkling of sugar and a little milk. The child’s customary diet should not be resumed until four weeks have elapsed from the commencement of the attack. If the case has been severe, showing marked systemic infection, six weeks should elapse before the full diet is resumed.

*Bowel Evacuation.*—If at least one evacuation of the bowels daily does not take place, a soap-water enema should be given. If, on account of the diet and the recumbent position, there is a tendency to constipation, a glass of malted milk—6 teaspoonfuls of the malted milk to 8 ounces of water—as a part of the evening meal will be of service in relieving the condition. The addition of 1 teaspoonful of cocoa will be acceptable when the taste of malted milk is objectionable.

*Laxatives.*—As a laxative during the acute febrile stage citrate of magnesia is very satisfactory. As a rule, children like it, and to those from two to five years of age it may be given in doses of from 2 to 4 ounces. In case it is not well taken, from 1 to 2 teaspoonfuls of aromatic fluid extract of cascara may be given.

*Specific Medication.*—There is no specific medical treatment for scarlet fever. Many cases have passed through the entire illness without the use of any other measures than those suggested above.

*Nursing.*—As the course of scarlet fever is distinctly self-limited, much can be done in the most severe cases to prevent complications and to relieve the patient of his temporary burden and preserve his natural resistance. This we have done in no small degree when we have so arranged for clothing, diet, fresh air, bowel evacuation, sleep, and quiet as to insure the child’s comfort and well-being. The amount of vitality wasted by an uncomfortable, restless child in twenty-four hours may turn the case from a successful to a fatal issue.

We fully believe in “spoiling” a sick child. If a child is more at ease with the mother, the mother’s place is with the child. If the mother’s presence disturbs the child, as it does in some instances, she should be kept in the background. If it is apparent that the nurse selected is not

to the child's liking, or not adapted to the case, another nurse should be secured. A physician may be obliged repeatedly to take his best nurses from children gravely ill, because the patients are irritable and unhappy under the supervision imposed.

*Quiet* is most necessary. One person only should be allowed in the sick-room with a child very ill.

*Control of Fever.*—It is a safe rule not to allow the temperature to go much above 104° F. A higher temperature than this necessitates an overworked heart. For the purpose of controlling the temperature, a fifteen-minute sponging every hour with water at 90° F. may be tried.

*Packs.*—If sponging does not answer, the pack (p. 841) should be brought into use. The mere existence of a rash is no contraindication to the application of moderate cold to the skin. The pack may be used in scarlet fever, just as in pneumonia or typhoid fever. The fear that the disease may "strike in" and kill the patient is one of the many inexplicable ideas of the laity with no foundation in fact. The child is placed in the pack at 95° F. It will rarely be necessary to reduce the temperature of the pack below 80° F. If the case is of the fulminating type, with persistent high temperature, the pack may gradually be reduced to a temperature of 70° F. In thus reducing the temperature the towel is not to be removed from the patient. He is turned from side to side and the towel moistened with water at the desired temperature. Time and again the observation has been made that a child who was tossing about the bed, delirious and sleepless, falls into a quiet sleep when placed in a pack. With a reduction of the temperature there is a corresponding diminution in the pulse-beats of from 20 to 30 a minute.

*Tub-baths.*—The full tub-bath at a temperature of 95° F. for ten minutes at the commencement of a case in which there is a great deal of restlessness and irritability will often act most satisfactorily in quieting the patient. Tub-bathing, however, requires a great deal of handling of the patient, and in the cases in which there is persistent high temperature, and in those in which it mounts up suddenly after the bath, the pack is far the more satisfactory. In some cases with intense prostration, high fever and cold extremities, the warm bath—105° to 110° F.—for ten minutes will have a most satisfactory effect, the fever being thereby reduced, the child quieted, the heart action improved.

*Oil Inunction.*—The itching and burning of the skin in scarlet fever is most distressing. This is relieved to a considerable degree by the pack. The child's comfort will be augmented by an inunction twice daily of cold cream or liquid petrolatum. Vaseline or olive oil may be used, but they are much less satisfactory. Vaseline acts as an irritant to some sensitive skins.

During the period of desquamation the oily applications largely prevent a free distribution of the scales.

*Stimulants.*—If during sleep the pulse is over 150 a minute, and the cardiac first sound is weakened, a heart stimulant is necessary. To a child one year of age 1 drop of tincture of strophanthus at two-hour intervals, or an equal amount of the tincture of digitalis, should be given. On account of its being well borne by the stomach, the tincture of strophanthus is at times to be preferred. Strychnin is a remedy of

considerable value as a stimulant. When the pulse is soft and the heart action shows a tendency to irregularity, 1.200 grain may be given every four hours to a child from one to three years of age, and 1.150 grain to a child from three to six years of age, at intervals of four hours. Alcohol should be used only in the septic, asthenic cases when other forms of stimulation have failed. In such instances it should be used freely. In a few cases very large quantities have been used with striking benefit. One-half dram of whisky, at first given every two hours, may be increased gradually until its beneficial effects are noticed on the heart action. It is astonishing how much alcohol may be given, in a profoundly septic case, without the slightest effect except an improvement in the heart action, and a corresponding improvement in the child's general condition.

*Care of the Throat and Nose.*—The throat and nose demand our attention during the acute stage. For the nose toilet of older children a solution of menthol and liquid petrolatum, 1 grain to 1 ounce, may be used by means of an atomizer, and for the very young by instillation with a medicine-dropper. Forcible syringing of the nose of a young child is not a safe procedure even in the most skilled hands. Local treatment of the throat depends entirely upon its condition. If the mucous membrane is swollen, edematous, and covered with a glairy, mucopurulent secretion, if there is a pseudomembrane, or if there is much pain or discomfort upon swallowing, the child may be made to gargle, if old enough; or, far better, the throat may be irrigated with hot saline solution at 120° F. This is done in the manner described on p. 321. Force will be required with the very young. In older children the relief from pain that is experienced from free irrigation is so great that usually the child takes the tube in his mouth gladly for the future irrigations. The use of antiseptic gargles and washes has not seemed to possess any value other than that of cleanliness, and free douching accomplishes this in a far more satisfactory manner. Suction in competent hands is here a valuable aid (see p. 701).

**Specific Serotherapy.**—Even before the discovery of the specificity of the streptococcus of scarlet fever the use of convalescent serum was carried out by various investigators in the belief that it favorably influenced the course of the disease; and in 1914 Zingher reported favorable results from administration of whole convalescent blood intramuscularly. The most promising results thus far achieved have been obtained by Dochez,<sup>1</sup> who has been able to produce a relatively high degree of immunity in the horse to the organism which he had employed in producing the disease experimentally in guinea-pigs.

The results already obtained by the practical use of immune serum thus obtained from the horse have been highly encouraging, and justify confident belief in the success of the method when it is more widely available.

**Treatment of Complications.**—*Cervical adenitis* is a very frequent complication, and when suppuration occurs, it is most troublesome. On the first appearance of a swollen gland a cold compress should be applied and then kept on constantly day and night, until the swelling has materially subsided.

The temperature of the water should be from 50° to 60° F. The compresses should be changed every thirty minutes during the day and

<sup>1</sup> Jour. Amer. Med. Assoc., 82, 542, February 16, 1924.

at least every two hours during the night. Several thicknesses of old linen, such as are furnished by a table napkin, answer well as a medium for applying the cold. The material used should be cut of sufficient length to extend from ear to ear under the jaw. In order that the moisture may be retained oiled silk or rubber tissue may be placed over the dressing, and over all a thin gauze bandage pinned together on top of the head.

*Otitis* is a complication to be looked for in cases of scarlet fever. In view of the grave possibilities of mastoid involvement, sinus thrombosis, and jugular bulb infection, the presence of pus in the middle ear should be promptly detected, and the pus evacuated by a free incision of the drum membrane. The presence of middle-ear infection may be suggested by a pain or a sensation of fulness in those old enough to locate it. In infants, restlessness, sleeplessness, or tenderness on manipulation in cleansing the ears may be the only objective sign of the trouble. In the majority of cases of otitis none of the above signs of pain and discomfort are present. The ear involvement is suggested because of a continued elevation of temperature which is not otherwise to be accounted for. A persistent elevation of the temperature of unknown origin following scarlet fever is sufficient occasion for examination of the ears by an expert in otoscopy. As a routine precaution during the disease the condition of the drum membrane should be noted every day.

The incidence of otitis depends somewhat upon the character of the epidemic, but more upon the age of the patient. The younger the child, the greater the danger of ear involvement. Many cases of deafness have had their origin in an attack of scarlet fever, and are due to somebody's ignorance or neglect. Among 185 cases of scarlatinal otitis reported by Bezold and quoted by Holt, in 30 there was entire destruction of the membrana tympani; in 59 the perforation comprised two-thirds or more of the membrane; in 13 there were small perforations; in 44 there were granulations or polypi; in 15 there was total loss of hearing on one side, and in 6 of the cases upon both sides; in 77 the hearing distance for low voice was less than 20 feet. May, of New York, collected statistics of 5613 deaf-mutes, of whom 572 owed their condition to otitis following scarlet fever.

The bacteriology of scarlatinal otitis is the same as in suppurative otitis developing with or following any other infectious disease, except that there is a greater tendency to severity because of the liability to streptococcus infection. Prompt relief demands prompt recognition of the condition of the drum membrane, with evacuation of the pus and suitable after-treatment. (See *Acute Otitis*, p. 662.)

*Cardiac Involvement.*—Heart complications are not particularly frequent in scarlet fever. Nevertheless the heart should be examined daily. Such complications have been present in about 2 per cent. of our cases.

*Nephritis.*—Early in severe infection there will often be discovered a transient albuminuria with a few hyaline casts. There may be slight suppression of the urine.

*Illustrative Case.*—In one case there was complete anuria at this stage of the disease. Within thirty-six hours, moreover, after the first sign of the disease in this case, the kidneys ceased to act, and on the third day the child died from the acute diffuse nephritis.

The condition of the kidney giving rise to albuminuria is best relieved through attention to the skin function by the use of a bath at a temperature of 105° F. every six or eight hours. The child may remain in the bath for ten minutes, during which time the skin should be vigorously rubbed with the bare hand. The tincture of aconite in doses of 1 drop, with 5 drops of sweet spirits of niter for a child eighteen months of age, will usually produce a satisfactory diaphoresis.

What is known as scarlatinal nephritis rarely appears before the third week of the disease and cases occur as late as the sixth week. The management of this complication is discussed on page 497.

*Arthritis* as a complication of scarlet fever is seen in only a few of the cases. There may be swelling or redness of the parts, or both these signs may be absent. Whether or not the swelling is present, the joints are very painful on manipulation. Affected joints should be wrapped in old linen, saturated with lead and opium solution, and the dressing renewed every six hours. The following lotion has answered well in a few cases:

R. Mentholis.....	3ij
Tincturæ opii.....	5iv
Spiritus vini recti.....	q. s. ad. 3vj

Soft linen is moistened with the lotion, wrapped about the parts, and covered with oiled silk or rubber tissue. The part affected is then wrapped in flannel or cotton-wool. The lotion may be freshly applied at intervals of from four to six hours. The only objection to its use is the odor of the menthol.

Internally, to a child four years of age, aspirin may be given in doses of 5 grains, with 10 grains of the bicarbonate of soda at four-hour intervals, four doses being given in the twenty-four hours. Salicylate of soda may be used in small doses; but, as this may be badly borne by the stomach, aspirin at times is preferable.

**Septic Rash Resembling Scarlet Fever.**—This type of rash is sometimes described in text-books as that of scarlet fever. An inoculation of the disease is supposed to take place through an abrasion or wound. We have never seen a case of true scarlet fever acquired in such a manner. One does see surgical cases, however, develop a septic rash which cannot be differentiated from the scarlet fever rash. In such cases the skin will desquamate on the body generally, but not on the hands and feet. There is no angina. Further, a case of this nature does not transmit the disease to others.

### TYPHOID FEVER

Typhoid fever is not a disease common to infants or very young children, although persons of any age may acquire the disease. It has been established that the fetus may be infected by the mother, different observers having proved that bacilli in the fetal organs and blood have reacted to the Widal test. Numerous cases are reported as occurring during the first months of life, but the fact that these cases are reported singly, and that such reports are commented upon and quoted by other writers, emphasizes the truth that typhoid in the very young is extremely rare.

In a large hospital and private experience, covering many thousands of cases of acute illness in children, during a period of over thirty years, the senior author has seen but 4 cases of proved typhoid in children under two years of age. The youngest was eight months old and another ten months old.

**Bacteriology.**—*Bacillus typhosus* was described by Eberth in 1880 and cultivated by Gaffky in 1884. It is short, it does not retain Gram's stain, and grows readily upon all ordinary laboratory media. Important characteristics of the organism are its viability and its inability to produce gas in any sugar medium. The *Bacillus typhosus* enters the human body through the gastro-intestinal tract, usually by means of polluted water, which, in turn, may contaminate milk, vegetables, and oysters. During the course of an attack of typhoid fever *Bacillus typhosus* may be cultured from the blood, rose-spots, feces, the urine, and exceptionally from the sputum. The bacilli are found in the blood in practically all cases of typhoid fever, most frequently during the first week, less frequently in each succeeding week. In the feces the organisms do not, as a rule, appear until the second week, when ulceration has begun; they thereafter remain present until convalescence is established. The urine rarely contains typhoid bacilli before the end of the second week of the disease, when they are present in about 25 per cent. of all cases. The urine may continue to show the bacilli for weeks or months after convalescence. In the gall-bladder the bacilli have been found years after an attack of typhoid fever.

*Bacillus typhosus* is found in pus from complicating suppurating lesions in typhoid fever, such as periostitis, osteomyelitis, synovitis, meningitis, peritonitis, and abscesses.

Typhoid carriers have been estimated by Russell to develop from about 3 per cent. of all typhoid fever patients. These persons may excrete the bacilli with the urine or feces for many years after an attack of the disease, and are, therefore, a menace to those about them.

Immune bodies develop and circulate in the blood of the patient with typhoid fever. One kind of immune body is the agglutinin, the presence of which is demonstrable by the *Gruber-Widal reaction*. This agglutination of typhoid bacilli by the diluted serum of a typhoid fever patient is not usually apparent until the second week of the disease, and may be delayed until the seventh week. The reaction is present, however, some time during the attack in 95 per cent. of all cases of typhoid fever, and is, therefore, a diagnostic aid of great value. (See p. 823.)

**Pathology.**—The lesions produced by typhoid are usually much less severe in children than in adults. Autopsies upon youthful subjects have at times revealed no intestinal lesions sufficiently severe to warrant the diagnosis. In nearly all cases, however, the small intestine is the seat of a catarrhal process, and although there may be no actual ulceration, the solitary follicles and Peyer's patches are reddened and swollen. The spleen is almost always enlarged. Doubtful findings may be substantiated by cultures from the blood and intestinal contents.

The origin of the typical lesion has been well explained in the following paragraph:<sup>1</sup> "According to Mallory, the essential feature of ty-

<sup>1</sup> Adami and Nicholls: *Principles of Pathology*, 1909, vol. ii, p. 439

phoid is a proliferation of the endothelial cells through the body, a change which he thinks is due to a diffusible toxin derived from the bacilli. The lesion in question is found in Peyer's patches, mesenteric glands, liver, and bone-marrow, as well as in the lymphatics and blood capillaries, but is proportionately more intense the nearer to the point at which the infecting agent gained entrance. The endothelial plates attached to the fibrous meshwork of capillaries proliferate, become fused into plasmodial masses or giant-cells, and act as phagocytes. They ingest the bacteria and slowly eat up the lymphoid cells, which thus gradually disappear. A few leukocytes are to be seen in the follicles, and within the crypts of Lieberkühn, but are not an important feature. Owing to the massing of these endothelial cells within the capillaries and the consequent obstruction to the blood-supply, the parts deprived of their nutrition undergo necrosis. The focal necroses in the liver and spleen are to be explained in the same way."

**Symptoms.**—We cannot agree with those writers who describe urgent symptoms early in typhoid.

The early manifestations in a great majority of cases consist in moderate fever, becoming a little higher each day, apathy, and drowsiness. The tongue is coated and there is loss of appetite. Epistaxis is a not uncommon symptom.

In children systemic poisoning from intestinal sources appears to have some selective action on the nervous system; thus, disturbed digestion, whether acute or chronic, is productive of dreams and night terrors. Gastro-intestinal disturbances, more than any other indirect factor, are productive of convulsions. In typhoid fever the central nervous system, similarly, is affected, but the effect is one of depression. The child is dull and apathetic. So indefinite are the signs that a diagnosis is impossible for days, and often it is just this feature of absence of diagnostic signs that arouses a suspicion of typhoid fever. Now and then a case is seen with stormy onset, high fever, delirium, and rapid pulse. In such cases there is usually an associated infection, such as an acute intestinal infection or one due to the pneumococcus.

**Nervous Symptoms.**—In mild cases the nervous manifestations may be slight or altogether lacking; or there may be apathy, drowsiness, stupor, and delirium. The temperature range and the nervous manifestations appear to bear little relation to each other; thus, with a low temperature range there may be pronounced stupor and delirium, suggesting the possibility of meningitis.

**The Pulse.**—The pulse-rate is a most characteristic sign. It is comparatively slow, decidedly out of relation to the temperature range—slower than in any other illness excepting meningitis. The pulse shows no irregularity in force or rhythm. One may find the pulse at 110 with a temperature of 104° F. This in itself is a most suggestive sign. The typical typhoid pulse is dicrotic.

The *spleen* is usually enlarged, the enlargement corresponding with the severity of the attack. The organ is usually palpable some time during the second week, but in mild cases may never appear below the free border of the rib.

**Gastro-intestinal Symptoms.**—Tympanites is the rule; this condition

may be extreme or of mild degree, or it may not exist. With suitable feeding tympanites may be largely eliminated.

Either diarrhea or constipation may be present. Here also the feeding of the patient plays an important part. Patients who are fed with large quantities of milk often have diarrhea or constipation, or the two conditions alternating, along with abdominal distention, high fever, and greater toxicity.

*Rose spots* may be absent, few in number, or scattered over the skin surface. They appear most often on the abdomen, but frequently also on the chest and back.

*The Blood.*—A fall in red corpuscles and hemoglobin is to be expected after the first two weeks. Leukopenia is constant and there is a relative mononuclear increase. The Widal reaction appears usually only after the first week and may be delayed until late in the course. This reaction, however, may persist for years after the attack. Positive blood-cultures may be obtained before the development of the positive Widal reaction even when the latter is obtained early in the disease.

*Temperature.*—The temperature range is variable. The usual range is 101° to 103° F., perhaps occasionally reaching 104° F. It is extremely rare for the temperature to continue after the eighteenth day. In typhoid a very high temperature is not always a bad prognostic sign.

*Illustrative Cases.*—In the case of a girl seen in consultation with Dr. Staub, of Stamford, Conn., there was a temperature range for eleven days of 104° to 106° F., and from 101° to 104° F. for ten days longer, the entire duration of temperature being thirty-six days. During the illness the child did not appear to be very ill.

In the case of a boy of ten years, who showed a positive reaction, the temperature lasted two weeks, but was never above 100.5° F. by mouth.

In the exceptional case of a ten-year-old girl the duration of the fever was only ten days.

**Complications.**—The complications of typhoid in children have been exceedingly rare in our experience with the disease, and fatalities have been of most unusual occurrence.

Intestinal hemorrhage of any severity is an exception, and perforation, in the case of a child, we have not known.

The fact that typhoid fever bacilli may be cultivated from the blood and urine implies that infection of various organs in the body may and does occur; thus the disease may cause pyelitis, peritonitis, meningitis, osteomyelitis, synovitis, otitis, neuritis, parotitis, phlebitis, adenitis, furunculosis, and abscesses. When bronchopneumonia occurs with typhoid fever, it is usually a terminal infection.

**Suspicious Diagnostic Signs.**—Apathy, drowsiness, a gradually rising temperature curve, with diarrhea, and perhaps tympanites.

**Diagnostic Signs.**—Positive Widal reaction; elevation of temperature, and pulse slow in comparison to the temperature; involvement of the central nervous system, drowsiness, stupor, delirium, enlarged spleen, and rose spots.

The Widal test may be corroborated by culturing the blood and urine and by examination of the feces.

**Differential Diagnosis.**—Any continued fever of unknown origin, until very recent years, would have been called typhoid or malaria. It

was only a few years ago that some of our best clinicians in this country and in other lands diagnosed as typhoid every continued fever which did not respond to quinin, and for which no adequate cause could be discovered.

With the exact means of diagnosis which are at our disposal at the present time there is no occasion for failure to differentiate malaria, typhoid, and the conditions with temperatures due to occult pus.

The nervous phenomena of typhoid, when particularly pronounced, may, upon inspection alone, closely simulate those of meningitis. In typhoid the respirations, if slow, are regular and of even depth; the pulse is slow and regular. In meningitis irregularity or some atypical condition characterizes the pulse; it may be very rapid—180 to 200—with a temperature of 101° or 102° F. The spleen is not typically enlarged in meningitis, nor are rose spots present.

*Acute miliary tuberculosis* may simulate typhoid. In tuberculosis of this form there is absence of all typhoid signs except the fever, which is usually very high in children of the typhoid age. The eruption and the mental dulness of typhoid are not seen in acute miliary tuberculosis. Enlargement of the spleen may be present in both diseases.

**Mortality.**—Many of the mortality tables are valueless. Statistics of cases and diagnoses antedating the Gruber-Widal reaction and the discovery of the bacillus in the blood, urine, and feces are inaccurate. Thus, in one series, in infants under one year of age, we find the mortality given as 50 per cent.

The mortality in private cases treated in homes or private institutions ranges from 2 to 3 per cent. In cases treated in hospital wards or in institutional homes it ranges from 8 to 10 per cent.

In 95 hospital cases Koplik lost 9 patients—a mortality of 9.4 per cent. Hensch, in 375 cases, had a mortality of 14 per cent.

**Antityphoid Vaccination.**—The prophylactic value of antityphoid vaccine has been abundantly established in both civilian and army practice. For an average child ten years of age one-half the adult dose should be given. Thus if 500,000,000 is given for the first dose, 1,000,000,000 for two subsequent doses at intervals of ten days, a total dosage for a child of ten years would be 1,250,000,000.

**Reaction.**—A reaction manifested by slight fever and muscle soreness and fatigue occurs in a small percentage of cases. The local reaction is slight, although there may be pain, tenderness, and a localized infiltrated area. The neighboring lymph-glands may show temporary enlargement and be sensitive to touch. This condition need cause no anxiety.

**Duration of Immunity Conveyed.**—According to the best observers immunity continues from two to two and one-half years, at the end of which time a reinoculation should be done.

**Advisability of Inoculating Children.**—Children who remain at home under careful supervision will not require inoculation, as the incidence of typhoid under such conditions is very small. Those who travel about, particularly in summer, going by train or boat, living in hotels and boarding houses, are constantly exposed to the possibilities of typhoid infection. Such children should have the advantage of antityphoid vaccination.

**Treatment.**—While usually the disease runs a shorter course in the child than in the adult, an attack means, at the least, several days of illness, and it may mean from three to six weeks. For this reason it is best to establish a sick-room régime, under which must be particularly considered the feeding, the bathing, the airing of the room, and the maintenance of absolute quiet. If the patient becomes very ill, but one attendant at a time should be in the sick-room.

*Bathing.*—The patient should be sponged twice a day, an ordinary cleansing bath being given. During the bath it is not necessary to uncover the body. Parts may be bathed and dried, after which other parts may be given attention.

*Mouth Toilet.*—Careful mouth toilet should be observed. Gingivitis and ulcerative stomatitis, with secondary involvement of the cervical lymph-nodes, are not infrequent complications in these cases.

*Disposal of the Excreta.*—The excreta from both bladder and intestine should be received in vessels containing a 1 : 1000 solution of bichlorid of mercury. Carbolic acid should not be used. The necessity for the attendants to wash their hands with soap and water after attending to the patient should be made very plain. Attendants should also be advised as to the proper disposal of the excreta. For children of tender age who still require the napkin it is best to dispense with the usual article and use cheese-cloth instead, several thicknesses of which may be made of the required shape and burned when soiled. The bed-linen should be changed every day.

*The Feeding of Typhoid Fever Cases.*—Contrary to the general practice, little or no milk should be given in many typhoid cases. A trial in practice of the early teaching that milk afforded the only diet suitable for this disease soon led to the discovery, on the contrary, that the less the milk given, the less was the tympanites, that without milk the temperature course was lower, that there was less tendency to delirium, and that the duration of the case was shorter and, as a whole, less severe. In fact, these observations bear out the teaching of Seibert, of New York, who was the first to advocate the non-milk diet in typhoid fever.

The diet preferred consists largely of gruels, made from cracked wheat, barley, rice, oatmeal, or any of the uncooked cereals. One ounce of the cereal is boiled for three hours in 1 pint of water. At the completion of the boiling, boiled water is added to make the quantity of the gruel 1 pint. If the gruel is too thick for drinking, more boiled water may be added. The gruel thus prepared is used as a "stock." It may be given plain, with salt or with sugar, or both. As flavoring, 2 or 3 ounces of chicken or mutton broth may be added. From 6 to 8 ounces of the gruel are given every three hours—five or six feedings in the twenty-four hours. The patient is encouraged to drink water, which is given between feedings. Lemonade, tea, and weak coffee may also be given between the feedings. Rice or other light cereal, which has been boiled for at least four hours, is given once or twice daily. It is best served with plenty of butter and sugar, with the aim of increasing the caloric content of the food.

The diet schedule for a typhoid patient, aged five years, would thus be practically as follows:

- 6 A. M.: Eight ounces of gruel with sugar or a small amount of broth added. Zwieback or dried bread and butter.
- 8 A. M.: A drink of weak tea with sugar, or the whites of one or two eggs with sugar in orange juice.
- 10 A. M.: Farina, cream of wheat, rice, served with butter and sugar, or maple-syrup and butter. Drink of weak tea or kumyss or matzoon, or perhaps a dried milk food, such as malted milk or Nestlé's food.
- 2 P. M.: Eight ounces of kumyss, matzoon, or skimmed milk diluted with gruel. Zwieback or dried bread and butter if wanted.
- 4 P. M.: Orange-egg sherbet, or a drink of lemonade or tea and sugar.
- 6 P. M.: Cereal (or gruel) with sugar and butter or with broth. If skimmed milk has not been given at 2 P. M., it may be given with cereal at this time.
- 10 P. M.: Gruel with sugar or broth, or with wine.

Later, when the tongue becomes clear and the breath loses its characteristic odor, scraped rare beef and soft-boiled eggs may be allowed. With the use of the more substantial foods, the number of feedings in the twenty-four hours is to be reduced to four.

It will be seen that the caloric requirements, 60 to 70 per kilo, for the five-year-old child, may easily be supplied by the above arrangements of the feeding, although the diet as arranged may not be ideally balanced. (It would be high in carbohydrates, rather low in fat, and perhaps deficient in protein, particularly during the earlier period of the treatment.)

Fat in considerable quantity is poorly digested by young typhoid fever patients. It may be given, however, in small amounts when mixed with other foods. Foods containing protein should not be given in considerable amount until we can predict the course of the disease. Milk, scraped beef, and soft-boiled eggs are often not well borne by young typhoid patients, and a temporary reduction of protein is not felt by them.

Carbohydrates, such as the cereals and the different sugars, are readily cared for when properly prepared and administered. They supply fuel, but no toxic by-products, and do not require immediate elimination from the body. Excessive emaciation is prevented through their action as protein spacers. Mendel and Rose found that the excretion of creatin induced by starvation is inhibited in rabbits by feeding a diet of carbohydrates, absolutely free from proteins and fats. When the carbohydrates are given in liberal amounts, the creatin entirely disappears from the urine. The creatin eliminated is not reduced by feeding a diet of fat alone or by a diet of fat and protein. Experimental interference with carbohydrate metabolism leads to the elimination of creatin, the presence of the creatin being due to true tissue or endogenous metabolism.

Milk should not be given in any considerable amount before the temperature has been normal for one week. Even then, in a case in which no milk has been given and in which there have been pronounced elevation of temperature and intestinal disturbance, the giving of milk may cause a rise in the temperature. In not a few cases in which the temperature was running a low course—from 100° to 102° F.—without the presence of tympanites or delirium, the fever has been seen to shoot up to 105.5° F. and the tongue become furred and the abdomen distended, following the administration of milk.

*Illustrative Case.*—A few years ago a girl twelve years of age had typhoid fever. The temperature was not high, the range being from 101° to 103° F. In fact, fever and

an enlarged spleen were the only signs of the disease, until the diagnosis was confirmed by a positive Widal reaction. The tongue was moist throughout the illness, as is not unusual when milk is not given. The family were fearful that the patient was not being sufficiently nourished. The mother had been told by a physician, a family friend, that such was the case. She begged that the girl be allowed one glass, 8 ounces, of whole milk daily. Accordingly the nurse was instructed to give the patient one glass of milk once in twenty-four hours. She did so, and in three hours after the first glass there was a rise in temperature to 106° F., with abdominal pain and distention. One bottle of the citrate of magnesia and a high enema were given, after which the disease resumed its usual course under the previous diet, without milk, the temperature not going above 99° F. after the seventeenth day.

Mortality statistics do not teach us all that may be learned regarding the disease or a method of treatment. The time element, as related to the duration of the illness and the duration of the convalescence, is important. Observation in the milk-fed cases indicates that the illness may be more severe, increasing the danger to life, and that the duration of the illness is longer. Emaciation may be much greater, and the convalescence consequently much more protracted than under the feeding indicated. The case in which the temperature period is cut down to fourteen to twenty days, and in which there is little emaciation and a prompt convalescence, should not be put in the same class with the case in which the fever lasts from thirty to fifty days or longer, with a convalescence of three or four months, although both patients have had typhoid fever and both have recovered.

It is argued that milk constitutes the ideal diet, for the reason that it contains all the nutritional elements required by the organism—fat, protein, carbohydrate, and mineral salts—which is the truth. It is further claimed that milk may be taken in large quantities and be readily digested, which is not true in the case of sick children. The addition of pepsin, hydrochloric acid, etc., has been of no value. In order to have a short case and a mild case the abdomen must be kept flat. Tympanites is an indication of danger, regardless of how it is produced. On the milk diet tympanites is the rule. On the mixed diet suggested it is the exception. So long as one can keep the belly flat he may feel that he has the case reasonably in hand.

*The High Caloric Diet.*—The applicability of high caloric feeding in typhoid fever, of which practice Coieman has been a pioneer advocate, seems to be unquestioned by those who have given this method a trial. The precaution, however, has been generally observed by those who have reported success, of giving the large allotment of food requisite to complete the assigned calories in the form of such articles as sugar, cereals, egg, and a moderate amount of cream, all of which are fairly well tolerated by most patients. We have had but little experience with this method. It would seem that in spite of its very apparent advantages such feeding necessarily imposes upon the physician extra watchfulness for the occurrence of untoward symptoms such as tympanites, constipation, and high fever.

*Drugs.*—With the so-called intestinal antiseptics in typhoid fever experience has been most unsatisfactory so far as concerns their influence upon the disease. If there is constipation, the citrate of magnesia, from 4 to 6 ounces, given cold, is grateful to the patient and usually proves effective. If the bowels do not move once in twenty-four hours,

a high enema should be given. The digestive capacity is indicated by the condition of the tongue and may be improved by the use of dilute hydrochloric acid and the tincture of *nux vomica*. The following will be suitable for a child from five to ten years of age:

R̄.	Tincturæ nucis vomicæ .....	gtt. xlviij
	Acidi hydrochlorici diluti .....	gtt. cxx
	Glycerini .....	ʒiiss
	Aquæ destillatæ .....	q. s. ad. ʒiv
M. Sig.	—One teaspoonful in water after each meal.	

As many as four bowel passages in twenty-four hours may occur without harm to the patient. In fact, from two to four may be considered necessary to maintain free drainage. When there are more than six in twenty-four hours, loose and watery in character, the loss of fluids sustained may be a serious factor in the case, in causing a concentration of the blood, with corresponding concentration of the poison, as shown in the marked general toxemia.

Diarrhea in typhoid is best controlled by the use of opium combined with bismuth. To a child from three to five years of age the following may be given:

R̄.	Pulv. ipecacuanhæ et opii .....	gr. x
	Bismuthi subnitrat. ....	gr. c
M. Div. et ft. chart.	No. x.	
Sig.	—One every three hours until the stools diminish in frequency, then at intervals of six to twelve hours if necessary.	

For children from one to three years old the dose of Dover's powder should be reduced one-half, the full amount of the bismuth being given. The amount required to keep the diarrhea under control will soon be learned. Of course, constipation must not be produced, for if a free bowel action is interfered with, there will be increased prostration and higher temperature.

*Control of the Fever.*—A temperature at or below 104° F. need not be interfered with in the great majority of cases. Of course, a very delicate child with a weakened heart action may require the use of antipyretic measures before this temperature is reached. This necessity, however, is unusual. When the temperature is above 104° F. the patient does better if proper means are used for its control.

Antipyretic drugs are rarely given. Quinin has never proved of the slightest value, even when given in large doses—15 or 20 grains in twenty-four hours to a child five years of age. The coal-tar products, such as phenacetin, may be used in small doses without harm if hydrotherapy is not applicable, as in a case recently seen in a remote country district.

*Illustrative Case.*—The patient was a boy six years of age. He was delirious at times, tossing almost constantly about the bed, and sleeping but little, with a temperature ranging from 105° to 106° F. The disease period was the latter part of the second week, and the patient was becoming rapidly exhausted. The parents, densely ignorant, refused to allow the bath or pack. Sponging, which was carried out indifferently, had not the slightest effect on the temperature and appeared to excite the patient. It was suggested to the attending physician that he give 2 grains of phenacetin and  $\frac{1}{2}$  grain of the citrate of caffein at intervals of three to six hours. From four to six powders daily were required to keep the fever within the desired bounds and the skin moist. This medicine had a decidedly quieting effect upon the patient, his

heart action was in no way unfavorably influenced and he made a complete recovery. Had the great restlessness, the loss of sleep, and the delirium continued undoubtedly there would have been a fatal termination.

While there is much truth in what has been written concerning the depressing effects of the coal-tar products, and while the dangers from their excessive use are realized, on certain occasions they are a necessity. One cannot help feeling that the dangers have been exaggerated. Probably the diseases in which the use of such drugs is most dangerous are pneumonia and the inflammatory conditions of the heart.

*Heart Stimulants.*—If the heart, by the rapidity of its action, shows signs of failure, the tincture of digitalis is our best remedy. When there is irregularity in force and rhythm, strychnin should be used. A child from five to ten years of age may be given 2 drops of the tincture of digitalis or strophanthus at intervals of two to four hours. Strychnin, 1/50 grain, at intervals of three to four hours, may be given for the same age. Alcohol should not be given as a heart stimulant until other means have failed. It is a drug to be used only in conditions of great stress. Its function is to carry us over and out of difficult places, and it may be given in the form of whisky or brandy, 1 to 3 drams at intervals of two to four hours for children from three to ten years of age. Its continued administration for a considerable period is not to be advised.

In any disease it is difficult to lay down definite rules for the administration of heart stimulants. They are used with the hope of producing a definite effect, and when such effects are produced, a larger quantity should not be given. It is best always to begin with small doses and gradually increase until the desired results are apparent.

*Hydrotherapy.*—Pyrexia is best controlled by hydrotherapy.

Sponging with lukewarm or cool water may be tried, and if the case is not severe, this may answer. The child may be sponged with water at from 80° to 70° F. for one-half hour out of every four to six hours. Sponging, however, even if it controls the temperature, may not be the best means of using water for this purpose, for the reason that many children object to it, and in consequence the sponging disturbs them, increasing their irritability and reducing their vitality.

The use of the bath for the reduction of fever in children has proved disappointing. They invariably object to it, the bath excites or frightens them, and, as a rule, particularly in the very young and delicate, the reaction following is poor. Moreover, the bath necessitates a great deal of handling, undressing and dressing, and therefore tires the patient.

Reduction of the temperature by means of a rectal irrigation with cool water has its advocates. If the temperature is running high and intestinal lavage is indicated for reasons other than the temperature, lavage may be used, the water being of a lower temperature than that of the body, though never lower than 80° F. Without a high body temperature, however, and other indications as well, irrigation is never advisable. It causes straining, excites the child, and thus increases the danger of hemorrhage and perforation. Furthermore, such irrigation is a very indifferent antipyretic, even when used as cold as 75° F.

By far the best means of reducing the temperature in children is

the cool pack (p. 841). Its advantages are that it causes no fright or shock to the child. He may be placed in a towel, which has been wet with water at 95° F. The only manipulation necessary is to turn him from side to side, so that the towel may be kept constantly wet with cool water at the desired temperature. The pack more effectually controls the temperature than does either sponging or the tub-bath. As suggested elsewhere (p. 841), the child should be removed from the pack when his temperature falls to 102° F.

**Hemorrhage and Perforation.**—Hemorrhage has not occurred in any children's cases personally observed in which the non-milk diet was given. In the event of hemorrhage the cold coil or the ice-bag should be applied and Dover's powder given in full doses to control peristalsis. In case of perforation, operative procedure is to be resorted to, but this holds out little hope. Children bear abdominal operations badly, and, considering the exhausted condition of a young child in the third or fourth week of a severe typhoid, the outlook is most unfavorable.

### MALARIA

Malaria is caused by *Plasmodium malariae*, a protozoön discovered by Laveran in 1881.

**Species.**—Three species of plasmodium are recognized, one causing tertian malarial fever; another, quartan malarial fever, and another, malaria of the estivo-autumnal type.

The tertian malarial parasite, which is the most common form, completes its development in the blood in forty-eight hours, and produces a malarial paroxysm every second day. When fully grown the tertian parasite is much larger than the quartan variety, which sporulates in seventy-two hours. The estivo-autumnal parasite produces the remittent form of malarial fever, with varying intervals between the paroxysms. The characteristic form of this plasmodium is the pigmented crescent.

The plasmodia of malaria enter the red blood-cells and live at their expense. The resulting anemia is due to the destruction of the large number of erythrocytes, the parasites deriving their pigment from the hemoglobin of the red corpuscles upon which they have fed.

For details concerning the morphology and biology of the organisms the reader is referred to standard works on clinical pathology.

**Transmission.**—Malaria is transmitted from one human subject to another by the bite of the *Anopheles*, a species of mosquito.

The fully developed parasites are most readily found in the blood an hour or two before the onset of the paroxysm.

Craig has stated that in malarial localities children suffer much more severely from the disease than do adults, and that malaria is often latent in young subjects. The disease may occur in very young infants, but is always of postnatal origin. Thayer and others have shown conclusively that malarial parasites are not transmitted through the placental circulation.

Malarial fever contracted in New York City is of very unusual occurrence. Patients coming under observation have, with few exceptions, resided elsewhere, or contracted the disease while in the country during

the summer. Every autumn a few cases of such origin are treated. They are usually of the tertian type.

**Pathology.**—The most marked pathologic changes in malaria are found in the blood, since the plasmodia feed upon the red blood-corpuscles. As a result, there is a marked reduction in the number of erythrocytes and in the amount of hemoglobin; there is, further, the production of a large amount of black and brownish-yellow pigment. The leukocytes are also decreased in number, while there is a relative increase of large mononuclear cells.

At autopsy upon patients dying of pernicious malaria characteristic lesions are found in the brain, spleen, and liver. The brain usually shows congestion and capillary hemorrhages due to blocking and rupture of the capillaries by plasmodia and pigment. There may be pigmentation of the gray matter. The capillaries contain infected blood-corpuscles, free plasmodia, free pigment, macrophages often large enough to block the vessel, and pigmented leukocytes. The nerve-cells show marked degenerative changes.

The liver is enlarged, fatty, pigmented, and congested. In the capillaries malarial plasmodia and pigment are seen within macrophages, but only very few plasmodia are found within red blood-cells. The liver-cells are degenerated, and sometimes pressed out of existence by the distended capillaries. Areas of focal necrosis occur with an increase in the connective tissue around them.

The spleen is enlarged and pigmented, and the pulp is soft and dark colored. The venous sinuses are congested, and there are many plasmodia free in red blood-cells, in macrophages, and in smaller cells; there is also free pigment. The splenic connective tissue is increased only in those cases in which repeated attacks of malaria have occurred.

The other viscera do not show specific lesions of any kind. All the capillaries contain malarial plasmodia, and there is present more or less pigmentation. The epithelial cells of the kidneys and adrenals are usually degenerated as the result of the toxemia. The heart may be flabby and anemic. The lungs may show congestion, edema, or bronchopneumonia.

**Symptoms.**—The symptoms vary somewhat with the age of the patient; thus, an infant, instead of giving evidence of a chill, which signals the onset in older children, becomes cold, blue, and pinched in appearance. Vomiting or convulsions may take the place of a chill. Whatever the nature of the immediate onset, fever follows, which rarely continues longer than five or six hours. This stage may not be followed by sweating. About the same time, on the following day or the day after, the same phenomenon is repeated. The patient is very comfortable between the seizures.

**Physical examination** of the patient will reveal enlargement of the spleen. The blood findings have been mentioned under Pathology. In neglected cases signs of malnutrition rapidly develop regardless of the age. They differ in no way, however, from those dependent upon febrile conditions due to other causes.

The extreme variability in size of the spleen as a result of malaria is not popularly appreciated.

*Illustrative Case.*—A fifteen-month-old Armenian boy, who had contracted malaria at eight months of age and had been given no regular treatment, came under the care of the junior author with malarial organisms in the blood, an erythrocyte count of 3,080,000, and a hemoglobin percentage of 35. The spleen was found upon careful palpation to extend to the anterior superior spine of the ileum in the nipple line, and to about 1 inch below the umbilicus in the midline, the arc of the lower border extending to about 1 inch below the midpoint of a line joining the anterior superior spine and the umbilicus. Response to treatment was immediate, and after the expiration of a little over a year the spleen was palpable only slightly below the ribs.

The possibility of at first confusing the picture in such a case with that of primary splenic disease is readily apparent.

**Relapse.**—When relapse occurs, it means one of two conditions—reinfection, or a case not cured. A relapse after weeks or months is not uncommon. Very frequently in cases which have been treated with quinin for only a week or two until the active symptoms subside, after a long period, another sharp attack results. The manifestations are occasionally milder. There is, perhaps, a low periodic temperature without chill, the temperature not reaching a point above 101° or 102° F. Time and again this feature of the disease has been evident. These cases represent what is sometimes designated as chronic malarial poisoning or persistent malarial infection. In non-malarial sections reinfection is an improbability.

**Diagnosis.**—The positive diagnosis of malaria depends upon finding the malarial organism in the blood. This is, as a rule, possible only when quinin has not been recently given.

The next best means of diagnosis consists in the use, in suspicious cases, of adequate doses of an assimilable preparation of quinin. An immediate control of the temperature is then strong presumptive evidence that malaria has existed. When full doses of quinin do not control the temperature, this fact usually means that malaria does not exist and that there is other cause for the illness.

**Differential Diagnosis.**—There are probably very few diseases with fever which have not many times been confused with malaria. In fact, the erroneous diagnosis of malaria has probably been made more often than all other diagnostic errors combined.

There are many conditions in which there may be a remittent temperature period, and which may be looked upon as malaria. An enumeration is unnecessary. Probably elevation of temperature due to occult pus is responsible for more diagnoses of malaria than is any other form of fever. Influenza, typhoid fever, pyelitis, tuberculosis, and periodic fever due to fatigue often evoke the mistaken diagnosis of malaria. With blood examinations and the various newer diagnostic methods there is no occasion for errors in differentiation.

**Prophylaxis.**—This consists in keeping the child free from the *Anopheles* mosquito. The administration of quinin in malaria-infected communities for purposes of prevention of the disease is a common and justifiable practice.

**Treatment.**—When it is demonstrated that malaria exists, quinin should be given in what may be considered large doses, if we are to use the adult for comparison. Children tolerate quinin well. In fact, a much larger amount comparatively is required than for adults. In giving quinin to young children, however, care must be used lest it excite

vomiting, and for this reason it should be given after meals in solution or in capsule. An excellent menstruum is a preparation of yerba santa, known as Yerbazin.<sup>1</sup> A child under eighteen months of age will require from 8 to 12 grains of quinin daily. Two to 3 grains of the bisulphate should be given at a dose, not more than four doses being given in twenty-four hours.

When the writer was resident physician at the New York Infant Asylum, then located in southern Westchester County, New York, there was a great deal of malaria among the women and children inmates. In that institution he repeatedly gave infants under four months of age 8 grains in twenty-four hours. In some cases at this age a larger quantity—10 to 12 grains—will be required. Quinin chocolate tablets are sometimes used for children. In using these tablets it must be remembered that the contained quinin is in the form of the tannate, and that 1 grain of the tannate represents about  $\frac{1}{3}$  grain of the sulphate. If sufficient quinin to be of value is given in this form, the large amount of chocolate in the tablet will almost surely upset the digestion. Lilly's "coca quinin" is a liquid, chocolate-flavored preparation apparently less likely to disagree. To children under one year of age with whom Yerbazin may disagree because of the sugar which it contains, the bisulphate may be given in solution in distilled water, followed by a teaspoonful of orange juice. For older children—from two to six years of age—from 15 to 30 grains daily will be necessary to control the disease. To these, as to the younger children, this drug should be given in one of the palatable liquid forms unless the child can be taught to take a capsule, when the quinin may be given in 3-grain doses at two-hour intervals until the prescribed daily amount has been taken.

The giving of a large dose of quinin a few hours preceding the expected chill does not answer well in treating children, as a large amount given at one time may frequently cause vomiting.

*Special Methods of Administration.*—The use of quinin by inunction or by the rectum has not been satisfactory. Its use by these methods was attempted at the Infant Asylum in a great many cases when difficulty was experienced in the gastric administration.

*Illustrative Case.*—With but one patient, aged two years, was it necessary to resort to *hypodermic* medication. The blood in this case showed the tertian parasite, and the disease resisted the internal use of quinin in large doses, but responded promptly to the muriate of quinin given hypodermically, 7 grains being used at one injection. There was no abscess at the site of the injection, and the child was permanently cured. To be sure, the administration of quinin was continued by the mouth, but the dosage of 16 grains daily was now apparently effective, where previously it had failed.

**Recurrence.**—The use of quinin in malaria should not be stopped abruptly upon a cessation of the fever. It is advisable to give the drug in full doses for one week after the temperature fails to rise unless there is a subnormal temperature, in which event the drug should be reduced one-half or temporarily discontinued. It is a difficult matter to determine when a case of malaria is cured. Time and again, weeks after it was supposed that a patient was well, a recurrence of the paroxysm took place. How often this was due to reinfection, and how often to the old

<sup>1</sup> Made by Lilly & Co.

infection which had not been entirely eradicated, it is difficult to say. We are inclined to the belief, however, that in many instances the plasmodium had remained inactive in the spleen in spite of the return of that organ to nearly its normal size, for the reason that the recurrence of symptoms sometimes took place coincident with some other illness with fever, such as tonsillitis or acute indigestion. Experience with recurrences of the disease has been such that, after an attack of malaria it is customary to direct that the child be given quinin for one week out of each month for an indefinite time—at least for a year following the original attack.

*Illustrative Case.*—A girl five years of age had repeated attacks for two years before coming under observation. The mother was instructed to give the child 12 grains of the bisulphate daily for seven days out of each month. This, without a change of residence, was sufficient to prevent a recurrence during the fifteen months which followed.

### INFLUENZA (LA GRIPPE)

Influenza is an acute infectious disease commonly ascribed to *Bacillus influenzae*, first described by Pfeiffer as a result of his studies during the great pandemic of 1889-90.

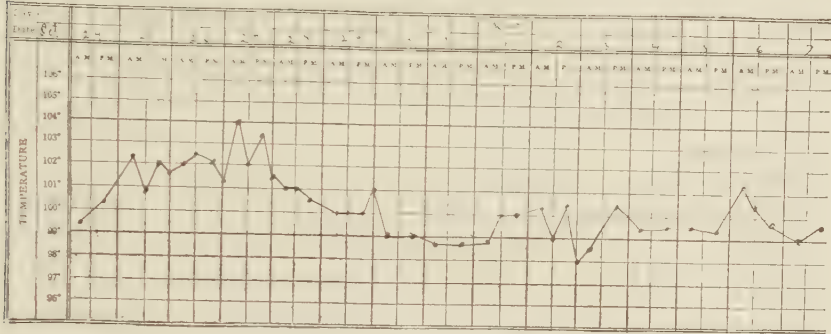
**Bacteriologic Etiology.**—It is a slender, non-motile rod, which stains deeply at the poles, does not retain the Gram stain, and is very pleomorphic. Its one unvarying characteristic is its utter inability to grow in media which do not contain hemoglobin. On agar mixed with human, pigeon's, or rabbit's blood, its cultivation is an easy matter. The colonies are small and dewdrop-like, they do not coalesce, and they do not cause hemolysis in the surrounding medium.

**Mode of Entrance.**—It is the rule for the influenza bacillus to enter the human body through the upper respiratory tract, whence it may travel down into the lung, causing bronchitis or bronchopneumonia. In comparatively few cases it is the cause of otitis media. General blood invasion with *Bacillus influenzae* is a rare condition, which is usually, but not invariably, accompanied by purulent inflammation of one or more serous membranes—meningitis, pleuritis, pericarditis, peritonitis, arthritis.

Since the pandemic of 1918 views concerning the etiology of influenza have been greatly modified and by many observers Pfeiffer's bacillus is no longer credited with being the specific cause. Undoubtedly an organism productive of a disease of such definite epidemiologic features and symptoms as those of the great pandemics of "flu," differs from that causing ordinary "grip." Whether the rôle of Pfeiffer's bacillus like that of the pneumococcus and streptococcus may not be that of a secondary invader is thus open to question. In any event, until our knowledge is more accurate, distinction between pandemic influenza and the other forms of grip is a difficult problem.

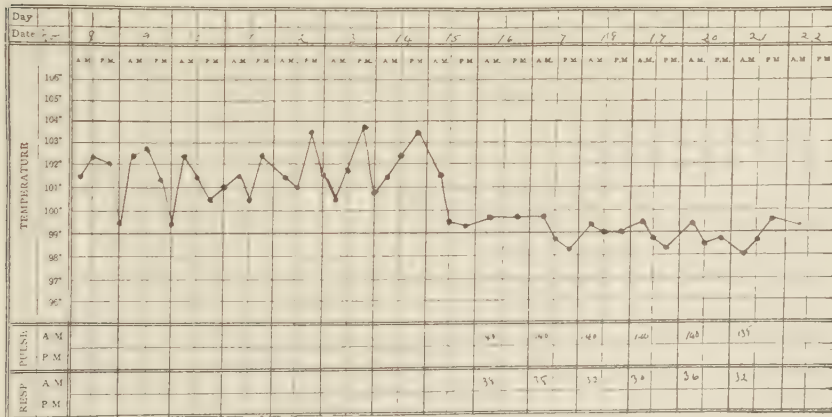
**Source of Infection.**—The source of infection is contact with an acute case of influenza or with a carrier. In either instance the secretions from the nose or bronchi contain the bacilli in a moist state. The organisms do not resist drying long enough to make clothes or linen a probable source of contagion, but they do remain viable for months in the bronchial secretion of cases of influenzal bronchitis, with or without

The work at the New York Babies' Hospital (Wollstein) has shown that the influenza bacillus is present in the bronchial secretion of young children far more often than is usually known, and that it is not pres-



ent as a saprophyte. Patients suffering from tuberculosis are very prone to infection with influenza. It may, in such cases, by causing a terminal bronchopneumonia be the actual cause of death.

**Pathology.**—Influenza produces no distinct lesion of its own. In the respiratory tract, where the bacillus is most active, there may be



only the changes characteristic of bronchitis or there may be a bronchopneumonia due to *Bacillus influenzae* in pure culture. The bacillus is most fertile in its power of producing lesions in various organs, but these lesions in no sense differ from those produced by certain other forms of infection.

**Incubation.**—The period of incubation may be very short. It is rarely longer than seven days, and may be but one or two.

**Symptoms.**—The onset of influenza is usually with sneezing, slight conjunctivitis, and cough. There may be a moderate fever—from 100° to 103° F. or higher. The throat is reddened, and there may be a few coarse râles in the chest. The symptoms subside, and the child is well in five or six days. After the second year children complain of head-

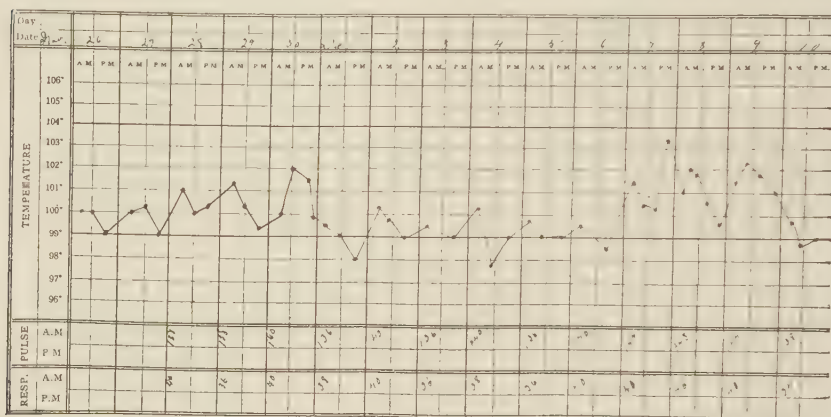


Fig. 120.—Prolonged influenzal infection.—(Continued.)

ache and muscle soreness; there is also a failure of appetite. This represents a mild attack of the type seen in a great majority of the cases. Severe cases show the above signs, with the exception that there are higher fever and much greater prostration. Convulsions are unusual, but headache and extreme restlessness are often present.

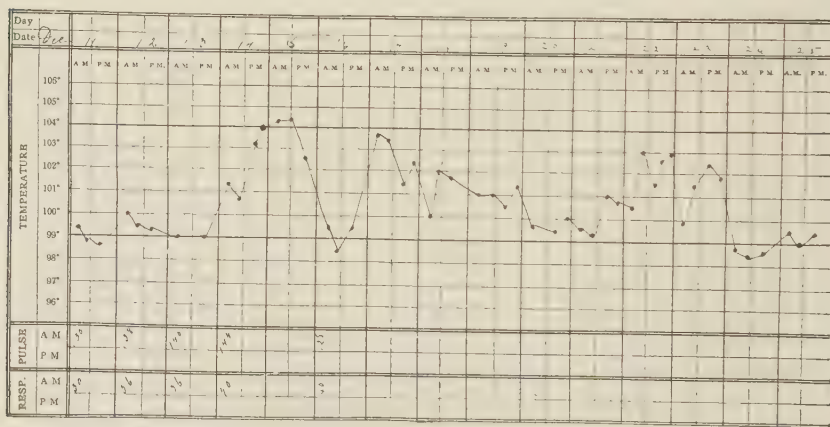


Fig. 121.—Prolonged influenzal infection.—(Continued.)

**Cough.**—The cough in the severe type is often most troublesome. The most severe coughs do not occur, necessarily, when bronchitis is a complication. The hard, persistent cough, without expectoration, without râles, or with but a few râles in the chest, may be said to typify

the cough of influenza. Every year we see patient after patient who has the nagging tracheal cough not only during the attack, but sometimes for weeks afterward, without a sign in the throat other than perhaps unusual redness, and without a chest sign. The influenza bacillus seems to have a special tendency for localization in the trachea.

*Gastro-intestinal Manifestations.*—Occasionally grip is ushered in with pronounced gastric disturbance indicated by nausea and vomit-

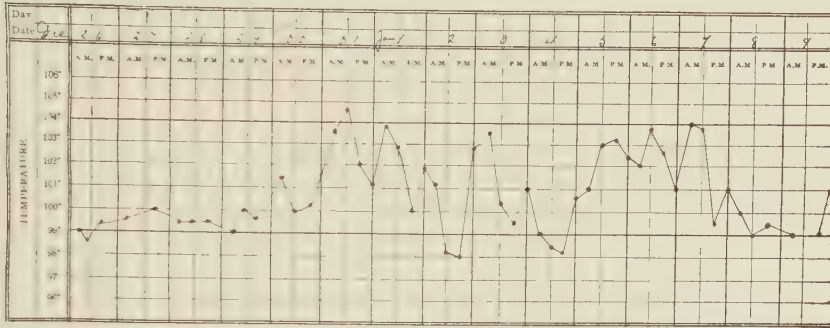


Fig. 122.—Prolonged influenzal infection.—(Continued.)

ing, no food being retained for twenty-four to forty-eight hours. Pronounced intestinal disturbance is by no means an unusual evidence of infection with the influenza bacillus; there may be diarrhea without any evidence of involvement of the intestinal structure, or there may be colitis with tenesmus, and mucus and blood in the stools. In not a few cases the so-called complications are the only manifestations of the

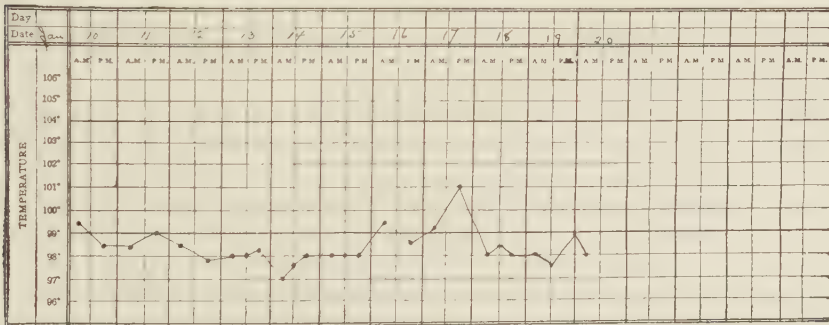


Fig. 123.—Prolonged influenzal infection.—(Concluded.)

infection. This has led writers to describe a "grip colitis," a "grip gastritis," a "grip pyelitis," etc.

The temperature characteristics of influenza are peculiar. There is a tendency to wide, irregular variations from normal to 105° or 106° F. and back again. One repeatedly observes temperature ranging from 100° to 103° or 104° F. for six or eight weeks (Figs. 118-123), without other lesion than that of a catarrhal bronchitis. A peculiar feature of these uncomplicated grip cases is the height to which the temperature will rise

daily and its long continuation for many days with insignificant signs of illness and absence of effects on the patient.

*Fatal Cases.*—Fatalities from uncomplicated influenza are unusual.

*Illustrative Cases.*—Two cases of grip in infants, in which the diagnosis was made by exclusion and verified by autopsy, occurred at the County Branch of the New York Infant Asylum during the winter of 1888 and 1889, which, it will be remembered, was the time when grip first visited this country in epidemic form. These healthy, breast-fed babies were taken with the disease, together with about 40 other inmates, mothers and children, in one of the large wards. The infants in question, aged three and four months respectively, were stricken suddenly with high fever and marked prostration. They quickly went into a condition of collapse, and both died in less than thirty-six hours from the onset. The autopsy failed to show any pathologic change other than a slight hypostatic congestion of the lungs.

*Complications.*—The influenza bacillus alone may produce otitis, meningitis, pericarditis, periarthrits, peritonitis, and nephritis of the hemorrhagic type. The chief danger attending its invasion of the body is its ability to prepare a field for the development of other pathogenic organisms.

The most frequent complication of grip is *bronchitis*, and that causing the most deaths is *bronchopneumonia*.

*Suppurative otitis* is not an infrequent complication; perhaps it would be better to class it as a grip sequela. Among 72 cases of acute suppurative otitis referred to elsewhere, 59, or 81.9 per cent., occurred with or followed immediately upon an attack of grip. Patients who, after an attack of grip, run a temperature without any apparent cause, should be examined by a skilled otologist.

*Adenitis* is a complication in many cases.

*Endocarditis* associated with grip is not infrequent.

*The Kidneys.*—In nearly all cases of severe infection a slight amount of albumin is present in the urine during the entire period, and occasionally, in a few cases, hyaline and granular casts are found. The irritation is only of temporary duration, and subsides after a few days.

In a very large experience with all types of influenza we have never known the association with grip of acute nephritis such as occurs with scarlet fever or the other exanthemata.

Every year we see cases of acute hemorrhagic nephritis complicating influenza. These cases are peculiar in that there is a large amount of blood with a few hyaline and epithelial casts. There is little or no suppression of the urine and no edema or sign of nephritis except the urinary findings. We have never lost such a case, although microscopic blood and casts have been present in the urine for several weeks.

*Duration.*—The duration of influenza may be two or three days or it may be two or three months. One attack of the disease confers no immunity. The long-continued cases are those of reinfection and recrudescence.

*Prognosis.*—The prognosis of influenza is favorable in the absence of complications. With complications the outcome depends upon the nature of the associated disease. Further, it is to be remembered that, as a complication of bronchitis and pneumonia, influenza supplies a decided additional danger.

*Diagnosis.* From simple internal colds a differentiation may be

impossible even by a bacteriologic examination. In influenza there is a tendency to chronicity and reinfection, with widely fluctuating temperature, irregular as to rise and fall. It seems most difficult for the patient completely to recover. Meningitis, malaria, and typhoid fever may be confused with grip, but may be readily differentiated by the well-known diagnostic methods. In any case of influenza the ears should be subjected to daily examination, as otitis may cause an elevation of temperature identical with that of a protracted case of uncomplicated influenza. Pyelitis should always be excluded.

**Sequelæ.**—After even a moderately severe attack of grip the patient is left in a condition that is peculiar to this disease and none other. He is habitually tired, easily fatigued upon slight exertion, shows but little tendency to take up active play, and, if older, finds school work difficult. In a large proportion of cases there is a slight elevation of temperature nearly every day—rarely higher than  $101^{\circ}$  F. A feature of these temperature cases is that the attack may not have been at all severe. Every winter and spring the writer is repeatedly consulted about the tendency to elevation of temperature after grip. In some cases the temperature will continue for months. It will be normal— $98.5^{\circ}$  to  $99^{\circ}$  F.—in the morning, perhaps  $100^{\circ}$  F. or thereabouts at noon, and  $101^{\circ}$  F. or a fraction higher at night. It rarely reaches  $102^{\circ}$  F. The persistent temperature cases are not due to disease processes or to the presence of the influenza bacillus in the bronchial tract, as has been claimed, but to constitutional weakness and fatigue. In some way, through the action of the toxins of the disease, the heat-regulating center becomes involved, and through activities which ordinarily would not produce any effect an influence is exerted causing an elevation of the temperature. That a portion of this deduction is correct may be readily proved by keeping these patients quiet in bed for three days, and taking their temperature at the usual intervals, morning, noon, and night (6 P. M.). It will be found, if they are kept quiet and the bowels active, that the temperature will remain within the normal limits—not above  $99^{\circ}$  F. This has been demonstrated in a great many cases. If fever continues uninfluenced, there is a discernible cause which should be discovered. After grip, because of the child's low physical state, he is often urged to take more food than he can assimilate, and there may be a mild degree of intestinal indigestion, producing sufficient toxic effects to cause the temperature, yet unobserved because of the absence of active symptoms. We have known the free use of milk and cream to produce a slight persistent elevation of the temperature after grip. Tuberculosis of the bronchial glands may produce a similar but less persistent temperature range.

**Quarantine.**—Individuals with influenza should be quarantined (p. 707) from other members of the household. Older members of the household are often the bacillus carriers and infect the younger members.

One attack of grip confers no immunity upon the patient; in fact, patients apparently reinfect themselves. For this reason we always advise that two rooms be used, when possible, one for the day and one for the night, the room not occupied during the day being aired for several hours with all the windows open. After recovery the sick-rooms should be thoroughly aired and cleaned.

**Treatment.**—The individual treatment is symptomatic. The rhinitis and bronchitis are treated as if the condition were not grip.

The management of an otitis, pneumonia, bronchitis, or colitis associated with or following an attack of influenza, differs in no way, so far as the immediate treatment of the complication is concerned, from that which would be advised if the case were independent of the influenza bacillus. The case, as a whole, however, will require closer watching, and on account of the greater prostration, better feeding and freer stimulation.

The hard, dry, teasing, tracheal cough associated with and following many cases of influenza, is sufficiently troublesome to require special mention. In this condition codein should be used in sufficient dosage partially to control the cough. The cough is difficult to relieve for the reason that the mucous membrane of the trachea is deeply congested. The infection, aided by the persistent cough, keeps up and adds to the congestion; and the irritation thus produced again tends to a persistence of the cough. This is a condition where opium is not only justifiable, but absolutely necessary, in order that sufficient rest of the parts may be secured to allow resolution and control of the infection.

**Vapor.**—Charging the air with vapor, producing an artificial humidity, greatly lessens the irritating effects on the mucous membrane of the ordinarily dry air of the living room, and relieves the cough.

**External Treatment.**—A preparation of mustard—1 part flour to 2 parts mustard—suitably mixed and applied to the chest for five to fifteen minutes at bed-time, will often insure a better night than would result were the application not made.

**Change of Climate.**—When possible, patients who show pronounced systemic depression and who fail to regain their usual physical vigor should have the benefit of a change of climate. A change of a few weeks will ordinarily completely restore the patient to his normal health. When at home, or elsewhere, convalescent grip patients who show slow response to treatment should have their activities carefully advised; they should not be allowed to arise before 10 in the morning, should have a midday rest of two hours, and should retire between 6 and 7 o'clock.

**Drugs.**—Small doses of quinin, 1 to 2 grains at two- or three-hour intervals, have given better results in hastening a return to health than any other form of medication. If there are malnutrition and anemia, the measures laid down under the respective headings may be applicable to these patients.

#### RHEUMATIC FEVER (ACUTE RHEUMATISM)

Acute rheumatism is a rare disease in young children. Although it is properly not to be regarded as a transmissible disease, its infectious origin, which seems unquestionable, justifies discussion of the condition in this chapter. Disorders described as rheumatism in infants and children under two years are usually scurvy or infectious peri-arthritis. The latter is not at all unusual, and the possibilities of scurvy are always with us. Among 1027 cases of rheumatism, Still saw none under two years of age. Our own cases have all been in children after the third year. The majority of the cases occur between the fifth and ninth years.

It is a mistake to designate rheumatic fever or acute rheumatism as "acute articular rheumatism," as we see many cases in which the joint symptoms play a slight part, or no part at all, the heart bearing the brunt of the attack. Repeatedly, endocarditis or pericarditis has been the main manifestation of the disease.

*Illustrative Cases.*—*Case 1.*—A boy came to the Out-patient Service at the Babies' Hospital because of sore throat and a temperature of 101° F. There was a very mild tonsillitis, and for one night there had been pain in the left knee. An examination of the heart showed an extensive endocarditis involving both the aortic and mitral valves.

*Case 2.*—A girl, four years old, subject to periodic colds and asthmatic bronchitis, had a mild seizure of this nature, requiring that she remain in bed for a few days. During examination of the lungs a soft systolic cardiac murmur was detected. Three days later pain and swelling appeared in a knee-joint. A polyarthritis followed, involving in all nine joints. In this child the heart involvement preceded the joint symptoms several days.

It is not at all unusual to see endocarditis in the offspring of the rheumatic, without the previous existence of a painful joint. These cases, however, will afford the history of chorea or recurrent spasmodic bronchitis, frequent anginas, periodic gastric or intestinal crises, or growing pains. In fact, endocarditis is far more often the manifestation of acute rheumatism than is inflammation of the joints.

On the other hand, many cases are seen in which the heart remains free, with the joint involvement of a most urgent nature.

**Etiology.**—That acute rheumatism is a manifestation of some form of infecting agent, the majority of the profession are agreed. It will probably be demonstrated that more than one infecting agent may cause acute rheumatism in a child predisposed in the manner that we shall attempt to describe presently (p. 738). Perhaps it will be proved that both bacterial and other toxic agents may cause the disease.

The discovery of the specific infecting agent in acute rheumatism is, however, still a problem. That the tonsils often constitute the atrium of the infection is well established. Similarly, a diseased sinus or antrum or adenoid growth may be a site for establishment of a focus from which rheumatism is derived. Numerous writers affirm that diseased teeth and infected adjacent structures are often sources of infection.

**Symptoms.**—(For Endocarditis, see p. 418.) Like all diseases of an infectious origin, acute rheumatism may be so mild as to escape notice, or it may be most severe. In the *joint type* the first symptom is pain in the joint; this may be very slight, or it may be most intense—so intense that the bed-clothing may not touch the parts without increasing the pain. Between these two extremes there are all degrees of involvement. There may be neither swelling nor redness, or the swelling may be extreme, with marked redness, the part being twice as large as its uninvolved fellow. One joint or several may be affected. The pain and swelling usually begin in one, and subsequently affect others. The first joint to become inflamed is usually the first in which the inflammation subsides. In no other joint affection does the pain compare in severity with that of acute rheumatic arthritis. The rapid onset and corresponding occasional rapid subsidence of the inflammation suggest that it may be the reaction to a toxemia and not to a bacteremia.

The duration of the attack is subject to much variation, it may last but a few days or for six weeks or longer. A case of average severity rarely lasts longer than two or three weeks. There may be no fever, or the temperature may range from 103° to 105° F., depending entirely upon the severity of the infection.

**Special Manifestations.**—*Peliosis rheumatica* and *pleurisy*, giving evidence of an etiology similar to that of acute rheumatism, are considered on p. 742.

*Erythema nodosum*, another manifestation probably of the rheumatic class, is discussed on p. 636.

**Rheumatic Nodules.**—The presence of definite nodules in cases of rheumatism in children is only occasionally noted in this country.

In England they are often encountered and were first described by Barlow. John Thomson<sup>1</sup> looks upon them as extremely important manifestations of rheumatism from a diagnostic standpoint and interprets their presence to indicate that the disease is in a serious and progressive form. He has found them present in a considerable proportion of rheumatic subjects, varying from the size of a pinhead to that of a pea or larger. Generally only a few are found at a time, usually over the bony prominences of the elbows, knees, and ankles, but occasionally they are present in large numbers, growing not only about all the bony prominences of the limbs, over the vertebral spines and under the scalp, but also on the ribs, clavicles, scapulæ, and iliac crest, and over the prominent tendons of the extremities, the fasciæ of the erector spinæ and abdominal muscles, and even rarely on the rims of the ears. The nodules are never reddish and are not tender. They appear in crops lasting usually a few weeks, sometimes several months, and rarely more than a year.

Brenneman,<sup>2</sup> in a review of the literature on rheumatic nodules, has affirmed his ability to tell by a glance at the knuckles on which the nodules are apparent: "This child has rheumatism; it is probably active; it is severe; he has an endocarditis." In our own cases the disease has assumed a prolonged course without the acute symptoms of high fever and extreme pain characteristic of many cases of acute rheumatism, and the existence of endocarditis as a complication has been practically constant.

The subcutaneous rheumatic nodule is said to be homologous with those that form on the valves and mural endocardium in acute rheumatism, and is evidently the product of local rheumatic inflammation.

**Prognosis.**—The prognosis for the immediate attack in articular rheumatism is good. All cases terminate in recovery if there is no heart involvement. When there has been one attack, however, there is great probability of another, and parents should be made to understand this feature of the disease.

**Precaution.** In every case of joint rheumatism the heart should be examined daily for evidence of endocarditis and pericarditis.

**Treatment.**—*General Management.*—Rest in bed is an absolute necessity even in the milder cases. The diet of the patient may consist of milk, junket, gruel, toast, stale bread, weak tea, stewed fruit, and orange juice. Vichy and lemonade may also be given. There should be one evacuation of the bowels daily.

<sup>1</sup> Clinical Study of Sick Children, 1921. <sup>2</sup> Amer. Jour. Dis. Child., September, 1919.

*Local Measures.*—Considerable comfort may be furnished by local measures, which will permit the child to sleep, resulting in a much improved food capacity. The affected joint or joints should be comfortably supported on a cushion or pillow, and the parts kept well protected by cotton-wool or flannel dressings. The U. S. P. lead-and-opium solution, if used to moisten the gauze dressings, will aid in relieving the pain. The joint should be loosely wrapped in strips of linen which have been wet with the warm solution. Over this should be placed oiled silk to prevent rapid evaporation, and over all a flannel bandage. In the acute cases the dressing should be changed every hour until the pain is relieved. This can readily be done without disturbing the patient. A liniment composed of menthol, 2 drams, tincture of opium,  $1\frac{1}{2}$  ounces, and enough alcohol to make 6 ounces, applied on strips of linen and covered with oiled silk, is another local application which has been of considerable service in relieving pain. This dressing should be renewed every two or three hours as the case requires.

*Drugs.*—Various drugs, such as oil of wintergreen, aspirin, and combinations of the alkalies with the salicylates, have been used in a considerable number of cases. The most effective internal medication has been the bicarbonate in association with the salicylate of soda. The salicylate must be given in large doses. Two points, however, are to be kept in mind in the administration of large doses of salicylate to children: its depressing effect upon the heart, and the tendency to produce derangement of digestion, as evidenced by nausea and vomiting. The salicylate should never be given with the stomach empty. It is given to the best advantage after meals, and always in solution. For a child five years of age the following may be prescribed:

R.	Sodii salicylatis.....	3ij
	Elix. simplicis.....	3iss
	Aquæ.....	q. s. ad. 3iv

Sig.—One teaspoonful in plain water or in Vichy four times daily after meals.

There are about 24 teaspoonfuls in a 4-ounce bottle. The average teaspoonful, as is well known, holds more than 1 dram. Computing 24 doses to a 4-ounce mixture, we give this five-year-old patient 20 grains of salicylate of soda in twenty-four hours. The amount may be increased to 60 grains if the condition is serious. Larger doses than 60 grains for children of this age we consider not always safe, as such doses have been followed by irregularity of the heart action and cyanosis. The average child from eight to ten years of age will take 60 grains daily without inconvenience. At the third year 20 to 30 grains daily have been given repeatedly, with most satisfactory results. The bicarbonate of soda may be given in combination with the salicylate, but it is best given alone in Vichy or carbonic water between meals. To a child five years old or under, 60 grains should be given in twenty-four hours. For children from seven to ten years of age 60 to 100 grains daily is the amount required.

The dosage, both of the salicylate and of the bicarbonate of soda, should gradually be reduced as the condition of the child improves.

*The Rectal Administration of Sodium Salicylate.*—In not a few chil-

dren the stomach develops an intolerance of sodium salicylate, give it as we may. In such cases in order to secure respite for the stomach the drug may be given satisfactorily by the rectum. Twenty grains of the salicylate of soda is added to 3 ounces of mucilage of acacia and introduced by means of a No. 14 American catheter and a large bulb syringe, the catheter being inserted at least 8 inches into the bowel. The solution should be warm. It will be better retained if the child maintains a position on the left side for an hour after the injection. This dose should be repeated daily.

*Later Treatment.*—It is incumbent upon the physician never, willingly, to let a child who has had an attack of acute articular rheumatism disappear from observation. As the outcome of repeated attacks, endocarditis is likely to develop sooner or later. After one attack the parents should be advised as to the probability of a recurrence and its dangers. Five days out of every fifteen 10 grains of the salicylate of soda, separately or combined with 20 grains of bicarbonate, should be given daily. This should be continued for six months, when treatment for five days out of each month will suffice. In some cases this method has been continued for several months.

In all cases of acute articular rheumatism in children the tonsils and adenoids should be thoroughly investigated and their removal advised if they are even suspected to be diseased. Foci of infection have also been found at the roots of the teeth. Therefore an x-ray examination of the teeth should always be made with a view to the removal of such foci.

### THE RHEUMATIC DIATHESIS

In a considerable proportion of the population there exist certain physical characteristics which set these individuals apart in a class by themselves. The constitutional condition referred to is well recognized, and various designating terms have been applied to it, such as the rheumatic diathesis, the rheumatic complex (Still), lithemia (Osler), and lithemic diathesis. The condition is, to be sure, but little understood. Nevertheless, if we admit that rheumatic fever (acute articular rheumatism) is due to a specific infecting agent, we must also admit that there is a favorable field for activity of this agent in certain members of the human race. Children who have the rheumatic symptom-complex as described below are those who most frequently develop acute articular rheumatism and endocarditis.

The more prominent features of the rheumatic symptom-complex comprise lack of resistance to infection of the respiratory mucous membranes and the tonsils; pronounced lack of nervous balance, manifested by habit spasm; and a tendency to a spasmodic condition of the respiratory tract, as seen in bronchial spasm and catarrhal laryngitis. Another peculiarity, as relates to the nervous system, is absence of control during play; the patients become much excited, and waste much energy over trifles. In the consulting-room one sees such children in ceaseless activity, which they apparently cannot control. They are very apt to lack concentration. They have frequent "growing pains" and suffer from periodic stomach and intestinal crises. They are, furthermore,

subject to eczema and urticaria. Children of this type are the offspring of those who have been similarly affected, or who have what they have learned to designate as rheumatism, lithemia, gout, or the uric-acid diathesis.

Often in the offspring of these individuals will be found a combination of the above tendencies; the association of eczema, spasmodic bronchitis, catarrhal laryngitis, and frequent rhinitis; of growing pains, chorea, and endocardial rheumatism; or of cyclic vomiting and acute bronchitis.

*Illustrative Case.*—In two brothers, who had cyclic vomiting, there was invariably an attack of tonsillitis first and then the vomiting, which was in turn followed by asthmatic bronchitis. None of the attacks were very severe, but each time the same sequence was carried out.

The above associations have been remarked in too many cases to ascribe them to a coincidence. Further, it is the child of this type who develops articular rheumatism and endocarditis.

**Etiology.**—The chemicophysiology defect appears to be in the nature of defective oxidation. At any rate, the more apparent bodily functions are not appreciably involved.

The age incidence is of interest. Infants who suffer from eczema, who are susceptible to bronchitis, and in whom it is of the spasmodic type, often show the rheumatic tendencies later in life. The more active manifestations, however, do not appear until the child has passed the period of infancy.<sup>1</sup>

**Treatment.**—It is obvious that children of the type described show not only a particular predisposition to certain affections but also decided lack of resistance to the particular form of infection which occasions acute rheumatism. The prevention of cyclic vomiting, recurrent spasmodic bronchitis, chorea, and the other conditions referred to depends upon a proper management of the so-called vice of constitution. Growing pains, habit spasm, tendency to recurrence of eczema, and the various nervous manifestations enumerated may be controlled largely through proper treatment of the "rheumatic complex."

The first and most important step in the treatment relates to diet.

**Diet.**—Children conforming to this class have a poor fat and sugar capacity, particularly for cane-sugar and cow's milk fat. The nearer the approach to a vegetable and cereal diet, the better for the patient.

The nitrogenous foods allowed are poultry, fish, and egg-whites. Sugar is not to be permitted. Vegetables, stewed fruits, and skimmed milk puddings may be freely used. Skimmed milk or buttermilk may be given with the morning and evening meal. All cereals are permissible.

There is no trouble in establishing a well-balanced ration. Children will readily learn to do without sugar. There is little or no trouble in feeding cereals without sugar. With stewed fruits and puddings, saccharin may be used in small amounts. Many children take stewed fruits, cereals,

<sup>1</sup> These observations and conclusions have been made in private practice. The hospital does not furnish an opportunity for observations on a child, carried through several years, as is necessary in order to know the patient from every standpoint. Those who have not had a large private work with children for a considerable period, or who have not carefully watched their patients, will not appreciate the conclusions expressed.

and puddings without a particle of a sweetening agent. Puddings and junket are to be made with skimmed milk. The fat in the egg yolk is particularly toxic to some of these children, particularly those who have cyclic vomiting. Egg yolks are accordingly not to be used in puddings. When one whole egg would ordinarily be used, the whites of two eggs may be used instead. A custard may thus be made as follows:

White of one egg.  
Saccharin.  
 $\frac{1}{2}$  cup scalded skimmed milk.  
10 drops of vanilla.  
10 grains salt.  
Stir white of egg with silver fork. Add milk gradually, salt, and flavoring. Strain and bake somewhat longer than for ordinary custard.

In many instances rheumatic children suffering from some one or more of the above-mentioned conditions, together with anemia and a stationary weight, coated tongue, and loss of appetite, have made astonishing gain without other treatment when the sugar and cow's milk fat were removed from the diet. Three meals a day should be given. A free daily bowel evacuation is to be insured (pp. 273-276).

If there is malnutrition, the scheme of living, as suggested in tardy malnutrition, is indicated (p. 147).

*The Bath.*—The child should be given a bath at bedtime, followed by a cold splash or douche. After the bath, while the feet remain in the warm water, a quart or two of cold water should be thrown over the body. The degree of cold may vary—80° to 70° F. at first; after a week or two water as it runs from the faucet may be used if the child enjoys it, regardless of the season. After the cool douche the patient should be vigorously rubbed with a bath towel and put to bed.

*Drug Treatment.*—The only drug necessary, other than perhaps an appetizer or a laxative, is bicarbonate of soda, which should be given in interrupted dosage—from 15 to 30 grains, three times daily, depending upon the age and requirement. The soda is best given after meals for ten days, with a free interval for five or ten days, when it may be resumed. After a period of a few weeks the soda may be discontinued, but the diet must be kept up indefinitely.

Lithemic children cannot bear alcohol, and it should not be included in their tonic or restorative medication. When there is a high degree of systemic poisoning which resists the above measures, sodium salicylate in dosage of rarely more than 5 grains should be given three times a day, after the interval method, in conjunction with the bicarbonate of soda.

All the measures suggested, without the withdrawal of sugar and fat largely from the diet, are of little avail.

*Illustrative Cases.*—*Case 1.*—A case which is characteristic of many was that of a two-and-a-half-year-old scion of one of America's most noted families. When the boy came under treatment he was having periodic attacks of catarrhal colds, associated with cyclic vomiting. The attacks would last for two or three days and were not very severe, rarely being accompanied by fever. He had been treated for these repeated colds by different physicians with expectorant drugs and local chest applications, all of which, as might be expected, were without effect. He was given the dietetic and drug management, as indicated above; and notwithstanding the fact that there had been attacks every fourteen days, there was but one attack in the two years under treatment. First cousins of this child had habitual colds with spasmodic bronchitis.

*Case 2.*—A most remarkable case was that of a girl who came under treatment in early infancy for an intense and obstinate eczema. From this she recovered, and when one year of age developed cyclic vomiting. During the next two years there were frequent attacks of cyclic vomiting, spasmodic laryngitis, and bronchial asthma. The association of these conditions has been previously referred to.

**Recurrent Bronchitis.**—Asthmatic bronchitis is often dependent upon the rheumatic state, and repeated attacks suggest the degree of the vice of constitution.

*Illustrative Cases.*—*Case 1.*—A girl eight years old had suffered from repeated attacks of bronchitis. The mother, a woman of unusual education and refinement, stated that the child had had an average of two attacks monthly during the previous year, and at least one attack every month since she was five years of age. On meeting the expression of some doubt as to the frequency, the mother stoutly maintained that her statement was correct. The family lived in Brooklyn, and had been told that the child could not remain there during any portion of the year. She had spent the colder months at different winter resorts, with very little, if any, resultant effect upon the severity or frequency of the attacks. There had been no other illness of consequence. The attacks were peculiar in that they were of short duration, but very severe. There was usually a temperature range from 100° to 101° F., associated with cough, difficulty in breathing, and occasional attacks of marked air-hunger. The attacks were always accompanied by severe coryza. The patient was seen at the end of an attack. She was pale and inclined to be over stout. An examination of the chest showed throughout a fairly even distribution of mucous râles involving the smaller tubes. Aside from the bronchitis and secondary anemia the examination was negative. The child had attended school at irregular intervals, but only for a few weeks of her life. In getting the history inquiry was made, as a matter of routine, if the child snored or if she was a mouth-breather. This caused the mother to remark that the child had been under the care of throat specialists at different times, and each physician had removed a set of tonsils and a set of adenoids! The mother did not think that there was very much left. There was no sign of a tonsil and the nasopharynx was free. In spite of a normal rhinopharynx, the colds had continued. The family was rheumatic on both sides for at least three generations. The mother claimed to have suffered a great deal from rheumatism. The child was fond of red meat and, according to the mother, lived on it, and cared for little else, with the exception of sugar. Here was a girl, eight years of age, who would not drink milk until sugar had been added to it. Cereals, stewed and raw fruits were loaded down with sugar before she would touch them.

In the instructions as to the treatment, red meat was allowed once every second day and sugar was reduced to a minimum—probably not more than one-fifth the usual amount being given. The child was to be bribed, if necessary, to eat green vegetables, cereals, and fruits. Expectoant and cough mixtures were discontinued. She was given 20 grains of the bicarbonate of soda and 20 grains of the salicylate of soda daily for three weeks. Later the drug treatment was continued at intervals during the remainder of the winter. She passed through the following winter without a sign of rhinitis, bronchitis, or asthma, although she continued to live in Brooklyn.

*Case 2.*—Another case somewhat similar was referred by a well-known rhinologist. The patient, a girl seven years old, had suffered from repeated attacks of bronchitis and asthma and had been confined to her home a greater part of each winter. Her general condition was thoroughly wretched. Her family physician had attributed the condition to enlarged tonsils and adenoids, and the child had been sent to New York for operation. The operation was performed, and the child returned to her home. As a result the patient could breathe easier and sleep better, and suffered much less during her attacks of asthmatic bronchitis; but the frequency of the attacks was in no way affected. Early the following summer the patient was again taken to the rhinologist, who, finding the condition of the upper respiratory tract satisfactory, referred the patient for medical supervision, remarking that he had "cut everything in sight and out of sight!" The treatment outlined was instituted, and while the results were not so flattering as in Case 1, the condition was much improved; only three attacks occurred during the next twelve months, and the child gained 15 pounds in weight.

Repeated inflammatory involvement of the mucous membrane of the upper respiratory tract in children, particularly in the absence of enlarged tonsils and adenoids, strongly suggests a rheumatic element as a prominent causative factor.

There are other conditions, apparently of rheumatic origin, which are not infrequently associated with the common manifestations.

**Rheumatic Pleurisy.**—In four cases thus diagnosed there was no pneumonia and no lung involvement of any nature. The fluid was sterile, and the patients never, in the years under observation, had further lung signs. The amount of fluid in each case was large. All the patients came for treatment because of interference with respiration. If there had been fever, it had in each instance subsided before the case came under observation. There was no pain and no evidence of discomfort other than the cyanosis caused by pressure.

In two of the cases there was a distinct history of rheumatism. These children were between two and six years of age.

**Treatment.**—The diet was given as outlined, with salicylate and bicarbonate of soda in dosage suitable for the age. In all the cases there was a complete absorption of the fluid in less than a week.

**Peliosis Rheumatica.**—In this unusual affection, which appears to be of rheumatic origin, purpura is a prominent symptom. In our patients the purpuric area has always involved the anterior portion of the lower extremities, and in every instance the disease has occurred in a patient who had had previous attacks of rheumatism or chorea, or in whom the rheumatic element was prominent, as shown by recurrent tonsillitis or recurrent bronchitis. A further proof of the rheumatic origin of the disease is the fact that the cases may yield readily to treatment for rheumatism.

**Treatment.**—In one patient there were two distinct attacks, both of which yielded fairly well to the salicylate of soda and the iodid of potassium. The medication and diet are the same as those suggested for rheumatism. In case erythema nodosum accompanies the condition, local measures for the relief of pain (p. 636) may be necessary.

#### RHEUMATOID ARTHRITIS; ARTHRITIS DEFORMANS; STILL'S DISEASE

Under the above headings may be noted those forms of chronic arthritis which occur independently of ordinary pyogenic infection, gonorrhea, syphilis, tuberculosis, rheumatism, and rachitis. Attempts at exact differentiation of the arthritides of this class rest in the main upon varying clinical manifestations which may or may not represent separate and distinct disease processes.

Rachford<sup>1</sup> has emphasized three types of "rheumatoid arthritis"—(1) *Chronic arthritis with hypertrophic changes predominant*; (2) *chronic arthritis with atrophy predominant*; (3) *Still's disease*.

The condition last named is sufficiently striking to require special attention, and the points emphasized by Still are here mentioned.

**Still's Disease.**—The specific *etiology* is unknown. The disease is probably of bacterial origin. Females are apparently slightly predisposed. Children are rarely susceptible after the sixth year.

The *morbid anatomic changes* comprise thickening and vascularization of synovial membranes, capsules, and ligaments of the affected joints, and, in advanced cases, moderate atrophic changes in the carti-

<sup>1</sup> Diseases of Children.

lage, with perhaps the formation of adhesions. Effusion is not an essential part of the process. Considerable enlargement of the lymphatic glands and spleen is a constant feature.

*Symptoms.*—The onset is usually gradual, but may be acute, with fever and chills. Primary stiffness in one or more joints is succeeded by progressive joint enlargement without bony involvement, ankylosis, or suppuration. The knees, wrists, cervical spine, fingers, ankles, and toes may be affected. Active and passive movements are restricted, and eventually atrophy and contracture of muscles may occur, without, however, impairment of electric reactions. The lymphatic glands are enlarged, particularly those related to the affected joints. The edge of the spleen may usually be found below the costal margin. The blood shows a moderate anemia and occasionally a leukocytosis.

Still's disease is to be distinguished from rheumatism, rickets, syphilis, the various forms of muscular atrophy, and caries of the cervical vertebrae.

The *prognosis* is not favorable. The disease is not directly fatal, but its effects are crippling. Koplik has reported a recovery.

The *treatment* of rheumatoid arthritis is largely symptomatic. An even climate, free from excess of moisture, is desirable. Anemia and malnutrition are to be combated in the usual manner. Massage and suitable applications may influence the local conditions favorably. In view of the possible influence of latent foci of infection upon the development of the disease, oral sepsis and intestinal putrefaction, especially, must be prevented.

Vaccine treatment is of possible value in cases in which the patient's serum shows reaction against specific organisms, *e. g.*, one or more strains of streptococcus. To this end joint fluid should be cultured.

## SYPHILIS

Syphilis is an infectious, communicable disease seen with great frequency in early life in all large centers of population.

*Bacteriology.*—In 1905 Schaudinn and Hoffmann discovered a spirochete in syphilitic lesions. From its faint staining reaction they named the organism *Spirochæta pallida*, and later *Treponema pallidum*. It is present in syphilitic lesions on the skin and mucous membrane, and has been found in the blood, in the internal organs, in the lymph-nodes, in spermatozoa, in ova, and in cerebrospinal fluid of syphilitic patients. The tissues and organs of still-born syphilitic infants contain the spirochete, and in congenitally syphilitic children the organism is readily demonstrable in the mucous patches in the mouth, in the fissures about the mouth and anus, and in the skin lesions. The older the lesion, the less numerous are the spirochetes.

Noguchi was the first investigator who succeeded in obtaining pure cultures of *Treponema pallidum*, and by inoculating such pure strains into rabbits he produced syphilis in these animals.

The spirochete is mobile, varying in length and thickness, its average transverse diameter being 0.2 to 0.3 micron. It is best seen in the fresh state, with the dark field illumination. A rough but fairly reliable method of demonstrating the spirochete is to mix the material to be examined

on a slide with a drop of India ink. By means of a piece of cigarette paper the mixture is easily spread evenly along the slide. Examination with the immersion lens shows the unstained spirochetes on a black background.

**Types.**—The disease in children is usually due to direct inheritance, although acquired cases are occasionally encountered. We have, accordingly, to consider both the hereditary and the acquired types.

For convenience of description hereditary cases are discussed under two headings: *Acute hereditary or congenital* and *late or tardy syphilis*.

#### ACUTE HEREDITARY OR CONGENITAL SYPHILIS

The severity of the infection in the offspring bears a distinct relationship to the severity and duration of the infection in the parent or parents. As in all infections, the disease may be most severe, or mild to such a degree that its existence is not recognized. A recent infection in either parent, or in both, produces the most active manifestations, many times sufficient to destroy the life of the fetus or even to preclude pregnancy. Death of the fetus, showing marked syphilis, any time before the ninth month indicates a comparatively recent infection in the parents. It is the parents in whom the disease is of long duration or who have undergone active treatment who are responsible for the tardy hereditary form.

**Symptoms.**—The symptoms, which are most variable, depend upon the age of the patient and the severity of the infection.

Thus the child may be born dead at term, perhaps almost denuded of skin and showing bone and extensive visceral lesions.

In other instances the child is born at term, alive, but shows syphilitic pemphigus and other lesions, and lives but a few hours. Other infants are born apparently normal and show signs of the disease before the sixth week. Symptoms are very apt to appear between the second and fourth weeks. Seventy-five per cent. of the senior author's cases have shown diagnostic signs before the fourth month. Some cases do not show signs until a later period—the sixth, seventh, or eighth month. Such cases, however, are unusual. The great majority show some active evidence of the disease before the sixth month. The first manifestation in congenital syphilis may, nevertheless, appear at any time up to the thirtieth year (Fournier).

In infants apparently normal at birth and developing the signs early the symptoms are as follows:

- (1) Restlessness.
- (2) Rhinitis; hoarse voice.
- (3) Enlarged liver and spleen.
- (4) Rash; condylomata; mucous patches.
- (5) Enlargement of epitrochlear glands.
- (6) Deformities of the nails.
- (7) Defective growth and malnutrition.

*Restlessness* is the earliest symptom of syphilis. The child sleeps poorly and is uncomfortable. This symptom is many times not appreciated by the physician and usually passes unrecognized by the parents. The restlessness is usually attributed to causes other than syphilis.

*Rhinitis* is a very early symptom that is seldom absent. It is characterized particularly by its persistence and the profuseness of the discharge; in other respects it may not vary from an ordinary rhinitis.

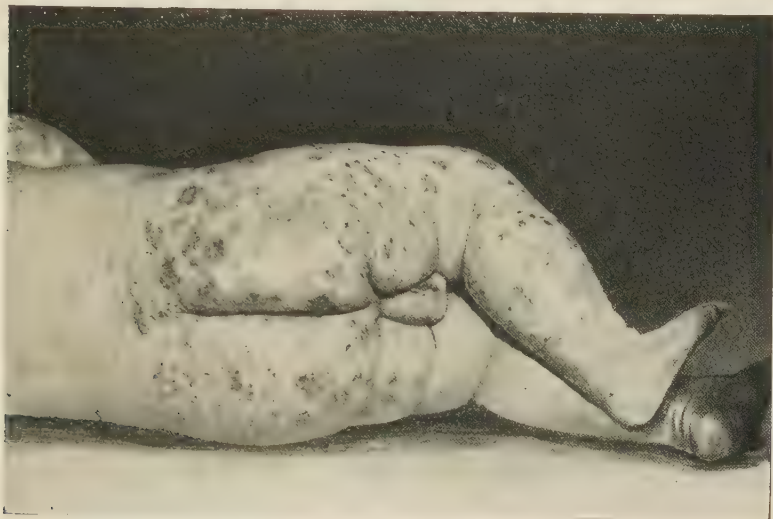


Fig. 124.—Rash in congenital syphilis.

In a considerable proportion of these cases there is a moderate degree of laryngitis with hoarseness. This may be the earliest and most prominent symptom.

*Liver and Spleen.*—An enlargement of the liver and spleen is an early sign in most cases. The spleen is ordinarily palpable below the ribs for

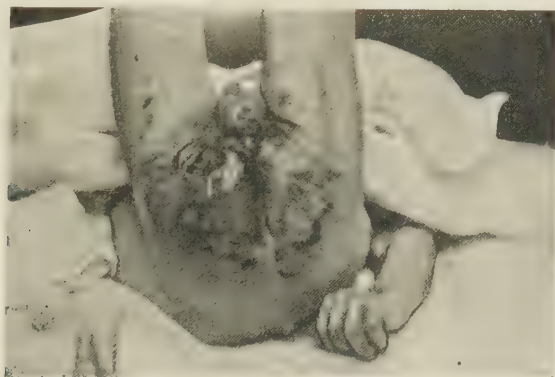


Fig. 125.—Condylomata.

$\frac{1}{2}$  inch to 2 inches. The liver also shows enlargement, often extending 2 to 3 inches below the free border of the rib.

The *rash* may appear very early or may be delayed for a week or longer after the rhinitis. The rash is fairly characteristic. It appears in discrete, brownish-colored macules (Fig. 124), rounded and with a tendency

to a very fine desquamation in the center. The skin between the macules may remain normal. The macules may occur in groups and become so

extensive as to coalesce and involve a large part of the skin surface of the patient (Fig. 126).



Fig. 126.—Extensive syphilitic rash.

The moist parts about the buttocks, legs, and over the abdomen are usually involved first and most extensively. There is no order, however, as to the appearance of the rash. The face and arms may be first affected, or the rash may be generally distributed over the entire skin surface. When the rash fades, the skin becomes smooth, but there is left a copper-colored stain which is as characteristic of the disease as the rash.

When the eruption occurs about the anus or the moist parts, as in flexures and skin folds, the eruption sloughs and condylomata are formed (Fig. 125).

In many cases, particularly in very young infants, a diffuse thickening of the skin of the soles of the feet and palms of the hands occurs with profuse desquamation (Fig. 128), leaving the skin of a glossy, shining



Fig. 127.—Fissures and mucous patches.

appearance. How long the skin eruption would continue, untreated, if the patient survived is difficult to determine. Under suitable medication the eruption largely disappears in two to four weeks, leaving the copper-colored disfigurations, which in turn fade, but require a much longer time (Fig. 126).

*Fissures* at the angles of the mouth and on the lip, and *mucous patches* (Fig. 127) are really a part of the skin manifestations—they are character-



Fig. 128.—Desquamation. Soles of feet. Congenital syphilis.

istic in the sense that they occur only in syphilis. A mucous patch represents the site of papule or macule on a moist surface. Such lesions



Fig. 129.—Syphilitic lesions in tibiae of a young infant.

are usually found on the mucous membrane of the mouth. Other possible sites are the anus and the female genitals.

*Acute epiphysitis* occurs in young infants, but in this country it is an unusual manifestation of syphilis. There is swelling of the epiphyseal cartilages and there may be separation of the epiphysis. The parts are very painful, giving rise to the term "syphilitic pseudoparalysis."

The *nails* are dwarfed, dry, and break readily. There may be exfoliation of the nail, but this is unusual in infants. A characteristic deformity is the bird-claw nail, in which the nail is much contracted, showing an arching of the dorsum of the nail with a thickening, and a downward curve at the free end, over the tip of the finger or toe, producing a typical claw appearance. This is a sign of much diagnostic value.



Fig. 130.—Bones shown in Fig. 129, B. The improvement took place in a period of five and a half weeks, following daily mercurial inunctions combined with four doses of 0.075 to 0.1 gm. of neosalvarsan, and the administration of cod-liver oil. (From the New York Nursery and Child's Hospital.)

*Hemorrhages* in congenital syphilis are rare. They may occur from any mucous surface. In a large number of cases of congenital syphilis seen in this country and on the continent there were but 2 in which hemorrhage was a symptom. In both these cases, strange to say, there was quite severe hemorrhage from the vagina.

*The Wassermann Test.*—This is positive in a very large percentage of cases, but is subject to variation dependent on such factors as age of the patient, previous treatment, and duration and severity of the infection. (See pp. 826-827.) A negative Wassermann test in the first months of life does not exclude the possibility of congenital syphilis.

*Treatment.—Mercurial Inunction.*—Formerly the only means of treating congenital syphilis in infants was by the use of mercury, either locally, as by inunctions, or by internal administration. The use of mercurial ointment by inunction is a satisfactory method in hospitals and in children's institutions, where a nurse can make the necessary applications; in private practice, however, it is objectionable because of the inunction itself, which may cause comment, and because of the staining of the skin. In fact, this treatment cannot well be carried on without other members of the family becoming acquainted with the nature of the illness. Definite rules for management, as regards kissing and the care of feeding utensils, should be given, so that the other members of the family may be protected

and the real condition remain unknown. Among the poorer class and in out-patient work the inunction method is usually unsatisfactory, for the additional reason that its use is not continued sufficiently, and it is very apt to be indifferently applied or else postponed and forgotten.

If the inunction is employed the mercurial ointment, U. S. P., should be used, 10 grains being rubbed into the skin daily. The rubbing should be continued about ten minutes, as this time will be required for the ointment to be thoroughly absorbed.

As the disease permits of no temporizing, it is for the interest of the patient that more effective means possible for its control be brought into use at the earliest possible moment; this is by the internal administration of mercury.

*The Internal Use of Mercury.*—The use of mercury internally gives good results among all classes. It is the writer's observation, after the treatment of several hundred of these cases, that the bichlorid of mercury in small, frequently repeated doses is the best form of oral medication. It is given in tablet form. Its use may have to be continued for a long time, and, as people are fond of giving drugs, we cater to the weak side of human nature, and thus do the greatest good to our patient.

For all infants under one year of age the scheme of medication is the same, and this covers the great majority of our cases. Usually the patient is seen before the third month. In this event the tablet triturate of bichlorid of mercury, 1/200 grain, is prescribed. The mother is instructed to give 2 tablets daily, morning and night, after feeding. She is told to give on alternate days an additional tablet after feeding, until 5 are given daily, or until the mercury produces loose green stools. It is comparatively rare that an infant of the tenderest age cannot take 1/40 grain daily without inconvenience. If green stools of a watery character result, the increase is temporarily withheld. It is very rare that the above amount will not ultimately be taken without inconvenience. Further, the dosage of 1/40 to 1/30 grain in twenty-four hours, in the great majority of the cases, is all that is necessary to control the disease. If an improvement does not take place after a week's administration, in the absence of intestinal symptoms, the amount may be increased to 1/20 grain in twenty-four hours.

If, after the administration four or five times daily of the bichlorid in the small doses of 1/200 grain has been continued for several days, improvement does not take place because of failure on the part of the child to absorb the drug, inunctions may be used in addition to the internal treatment.

*Arsenicals in the Treatment.*—The greatest value of the arsenicals is in the very severe congenital case. Repeatedly such infants die before the effects of mercury are manifested. The arsenicals act much more rapidly than mercury. In fact, the results of salvarsan treatment on the very severe congenital syphilitic border on the miraculous.

The chief value of salvarsan in pediatric work is, however, in cases of this type. For permanent, beneficial effects we are still dependent upon mercury and the iodids.

For babies under six months the average dose of neosalvarsan is 0.075 to 0.2 gm., and for older children 0.2 to 0.4 gm. Salvarsan is used in doses one-half as large. The consensus of opinion now seems to be that the arsenical should be given at weekly intervals until the gross lesions have cleared up. This treatment is always followed by the use of mercury. The arsenicals alone do not effect a cure.

*The Combined Treatment With Mercury and Neosalvarsan.*—A practical method of treatment for young children, devised by Fordyce and Rosen, is the intramuscular injection of mercuric chlorid put up in palmitin in individual collapsible ampules. The dosage is 1/10 to 1/8 grain or larger

for older children, and the injections are given at intervals of a week for about eight doses. Then weekly intramuscular injections of neosalvarsan in doses of from 0.075 to 0.2 gm., depending upon the size of the child, are begun and continued for about eight doses. The patient is then allowed a month's rest and the cycle again begun. The Wassermann is taken at this time. This course is repeated indefinitely regardless of the change in the serum reaction or clinical signs. In injecting both the mercury and the arsenical the Rosen needle is used. This is an ordinary 19 or 20 gage needle, from  $\frac{1}{2}$  to 1 inch long, with a curved phlange at the shank of the needle which fits snugly over the curve of the buttocks and prevents movement of the needle even when the child is squirming. The injection is made into the gluteus about 1 inch lateral to the intergluteal fold near its upper angle. Infiltration or abscess at the site of puncture may be avoided by injection deep into the muscles and rapid withdrawal of the needle upon completion, thus preventing the seepage of the drug into the subcutaneous tissues. Treatment should extend over a period of at least a year regardless of results. The question of the permanent cure of congenital syphilis is still debatable.

*Convalescence.*—In a typical case the first sign that the child is improving will be the fading of the rash. It disappears gradually, leaving the characteristic staining of the skin, which also clears up in a few weeks. Coincident with the fading of the rash the coryza becomes less pronounced and the hoarse voice becomes clearer. If there has been an enlargement of the liver and spleen, after a few weeks of treatment they will have diminished in size. The child gains in weight, and if the case progresses satisfactorily, soon looks like a normal baby. This, however, is not always the happy outcome. Occasionally we have patients with the vital powers greatly depressed or with so intense an infection that treatment is of no avail, and they die in a few weeks from marasmus.

The enlargement of the epitrochlear glands is a late sign to disappear, and in many cases these glands, though reduced in size, always remain enlarged without any other persistent evidence of the disease. A patient is considered cured who fails to give a positive reaction to repeated Wassermann tests of the blood.

*Later Treatment.*—What should be the further management of such a so-called "cured" case? Are we justified in discharging the patient and allowing him to pass from our observation? Experience proves the contrary, nor can we positively state that congenital syphilis is ever cured. We have seen many patients, however, who were apparently cured, and who showed no signs whatsoever of the disease. Against advice they have passed from observation for two, three, or four years, and then have reappeared for treatment because of the presentation of some manifestation of a tertiary character—a so-called "tardy hereditary syphilis." For this reason we believe every so-called cured congenital case should be subjected to the Wassermann test every two years or oftener.

#### ACQUIRED SYPHILIS

Acquired syphilis in children is a comparatively rare occurrence. The mouth is the most frequent site for the primary lesion, the genitals being rarely involved. Infection may be conveyed by direct contact,

as in kissing or by sexual contact. The virus may be conveyed by intermediaries, such as toys, nipples, and feeding utensils.

The recital of statistics and special modes of infection adds nothing to our knowledge of the subject. It is necessary to remember that a localized lesion, slightly sloughing over its surface, indurated and sharply defined, may be in a child the initial lesion of syphilis.

The **treatment** is the same as that of the hereditary form.

#### TARDY HEREDITARY SYPHILIS

In this form of syphilis the chief or only manifestation of the disease occurs at a later period of life. Fournier has stated that the first signs of the disease may appear as late as the thirtieth year. Whether the case in which positive signs are not observed until after the thirtieth year did not show unrecognized signs early in life is an open question. Most observers are convinced that an individual may show signs of syphilis at varying periods after infancy without early signs of the disease.

Several years ago the senior author reported 6 cases of tardy malnutrition of syphilitic origin in which there had been no early signs of the disease. Since that time he has seen several other cases of a similar nature.

The great majority of patients with tardy hereditary syphilis, however, are those who were treated in infancy in out-patient clinics or elsewhere and whose treatment was discontinued when the active symptoms were relieved. Many mothers cannot be made to bring their children for treatment and observation when they are apparently well.

**Pathology.**—*Eye.*—The eye changes are those of an interstitial keratitis, gummatous involvement of the iris, and the so-called deep inflammations of the eye, chorioretinitis and optic neuritis.

*Ear.*—Progressive deafness due to neuritis acustica (Ménierè's disease) is typical.

*Skin.*—According to Hochsinger, the changes in the skin do not differ from the tertiary skin lesions of acquired syphilis. He described two forms, small nodules, and large nodular late syphilids. The small nodules are due to a definite infiltration of the true skin, which presents a brownish appearance and may desquamate or become covered with a heavy crust. Beneath the crusts there is usually broken-down granular tissue. The large nodular syphilid occurs in the form of large skin gummata and gummatous ulcers arising from the subcutaneous tissues.

*Mucous Membrane of the Respiratory Tract.*—This structure may become invaded in a specific manner. It may be the seat of gummatous infiltrations or a rapidly progressive ulceration. Ulcerations of the pharynx and larynx are not rare. Such lesions are usually characterized by definitely defined borders and thick indurated walls. In the nose there may be a diffuse osseous and periosteal affection of the entire nasal skeleton, or a gummatous change may represent the primary pathologic process, followed by ulceration with much pus and crust formation. On the contrary, there may occur an atrophic condition of the mucous membrane. Levin and Heller have described a smooth atrophy of the base of the tongue characterized by absence of glandular tissue and thinness of the mucous membrane. Gummatous formation, as described above,

may occur on the velum palati, palatine arches, and uvula, with perforation. All the ulcerations show a great tendency to scar formation, with corresponding contractions and adhesions to adjacent parts.

*Lymph-nodes.*—A general hyperplasia of the lymphatic tissue of the pharynx and nasopharynx, including the tonsils, may take place, while in the lymph-nodes throughout the body, aside from general hyperplasia, gummatous formation is not uncommon. Occasionally the glands may undergo ulceration.

*Vessels.*—There may exist, according to Hochsinger, a gummatous aortitis, arteriosclerosis, and phleboscclerosis, while myocardial and endocardial changes have been observed.

*Viscera.*—Liver affections deserve the first rank. There may exist large nodular gummata; the diffuse hypertrophic cirrhosis is most common. These changes are almost always associated with more or less



Fig. 131.—Showing saber deformity of legs in tertiary congenital syphilis in a child nine years of age (Dr. Sill).

splenic hypertrophy. The kidneys may be small and contracted; amyloid degeneration is rare. Gummatous formation in the lungs may occur, but is very uncommon.

*Bones.*—Late syphilitic changes occur in the osseous system either as a diffuse hyperplastic osteitis and periostitis, or as a gummatous process. Lesions of both varieties, however, may occur at the same time in the same individual. According to Lannelongue, a hyperplastic osteitis and periostitis may involve the whole skeleton. The long bones are chiefly affected. The same author has considered that the so-called Paget's bone disease, which is a diffuse progressive periostitis leading to hyperostosis, is nothing more nor less than hereditary syphilis.

The tibia is the bone most frequently involved. The disease here produces what is known as the "saber deformity." (See Fig. 131.) Following the hyperplastic stage is the real stage of hyperostosis, the de-

formity being due to the continuous formation of new periosteal bone layers about the primary one.

Among the less frequent bone changes in late hereditary syphilis is a rarefying periostitis leading to bone absorption. This condition is seen on the surface of the cranial bones and causes the formation of rough areas (*caries sicca*).

Joint affection in late hereditary syphilis may take the form of a simple hydrops without capsular thickening or a hyperplastic synovitis. Again, there may be a combination of hydrarthrosis, with swelling of the joint-ends of the hollow bones, and in rare instances a condition resembling white swelling.

**Symptoms.**—This form of syphilis in the young may manifest itself in widely different ways.

*Errors in Nutrition* (see p. 755).—A not infrequent manifestation is that of moderate malnutrition and stunted growth. The patient is habitually pale, undersized, and shows lack of resistance, such evidences perhaps constituting the only signs of the disease.



Fig. 132.—Hutchinson teeth.

*The Bones.*—Characteristic signs are to be found in the bones and teeth. The shafts of the long bones are involved in a periostitis. (See Fig. 131.) The tibia when affected may show the saber deformity. The tibia is most frequently involved; next in frequency, the radius. Gum-mata may involve the flat bones of the cranium, although such an occurrence is comparatively rare. The "saddle nose" caused by a destruction of the septum is a condition not infrequently seen in congenital syphilis.

*The Teeth.*—Fairly characteristic signs, first described by Hutchinson, are often shown by the second set of teeth. The first set in no way give evidence of the disease. Hutchinson's teeth represent faulty development. They are variously described, according to the deformity presented, as "notched," "screw-driver," and "peg-shaped." (See Fig. 132.)

*Lymph-nodes.*—The only lymph-node involvement of significance is that of the epitrochlears. General lymph-node involvement is to be looked upon as corroborative of other signs of consequence.

*The Eye.*—A diffuse interstitial keratitis is one of the most frequent manifestations of tardy hereditary syphilis.

*Involvement of Other Structures and Organs.*—The spleen is usually enlarged, the liver not infrequently. Cases of brain tumor of syphilitic origin are occasionally seen. Juvenile tabes and paresis are sufficiently frequent to call for consideration in connection with suggestive neurologic signs. In fact, any portion of the body may be involved in a syphilitic process, and a detailed description of the various possibilities is out of place at this time.

**Treatment.**—Experience with the new arsenical preparations in tardy hereditary syphilis has been thoroughly unsatisfactory. As in the treatment of tertiary syphilis in the adult, likewise in the treatment of the late hereditary form in children, the iodids play an important part. Much better results, however, are obtained with the so-called "mixed treatment." The iodids alone are not sufficient to give us our best results, and the results with mercury alone are not so prompt and satisfactory as when the two drugs are combined. For an average case of periostitis involving the anterior portion of the tibia in a child four years of age, from 1/30 to 1/20 grain of bichlorid of mercury should be given daily, combined with sufficient iodid of potash to produce the characteristic coryza. This may necessitate the giving of from 12 to 20 grains of iodid daily, as children vary greatly in their susceptibility to the drug. The mercury and the iodid of potash should not be given in one mixture, as the combination is most disagreeable to the taste. It is far better to give the bichlorid in the form of tablet triturates. The iodid of potash is best given in a saturated solution, 1 drop of which represents 1 grain of the drug. This is best taken when dropped into milk after meals. Beneficial results from the treatment will usually be apparent in a few days. If there is a periostitis, the pain will be the first symptom to disappear.

The administration of the iodid of potash should always be interrupted, chiefly because of the possibilities of deranging the child's digestion. A good rule is to give the drug for ten days, followed by a rest of five days, when it is again resumed. Proper nutrition in these cases is a most important factor in their management. If the iodid is given to the point of tolerance, its omission for a few days will not be noticed. The mercury should be given for weeks continuously in doses of from 1/60 to 1/20 grain three times a day, graduated according to the age. Later, when the progress of the case shows that the disease is under control, the two drugs should be given alternately, for ten days each. How long this treatment should be continued must be determined by each individual case. The Wassermann test in these cases is of much service. Patients who are apparently cured should be instructed to report to the physician every three months. A course of treatment for three or four weeks two or three times a year is to be advised. A sufficient excuse for such action may be the condition of the child, who may show a tendency toward slow growth and improper nutrition. The patients should be kept under observation for years and should be seen at stated intervals until the adult period is reached, when the nature of the trouble should be explained to them. The disease from which such a child is suffering should always be made plain to parents, or at least to one of

them, in order that the patient may not be allowed to pass from under medical observation in ignorance of his true condition.

#### TARDY MALNUTRITION OF SYPHILITIC ORIGIN

The possible manifestations of syphilis in the young, as in the adult, are many. The infection may be so severe as to destroy the fetus, or so mild in its effects as to make recognition difficult. Not the least interesting and important of the cases showing remote manifestations are those in which late malnutrition is the *only evidence* of the syphilitic infection. The patients are usually thin, sometimes sallow, sometimes pale, with little or no adipose tissue. They are almost always under normal height, and always underweight; with poor appetite and little endurance and correspondingly little resistance. Those seen by the writer have been between three and ten years of age. None were mentally defective. When 2 such children are seen in a family in which both parents are robust, this circumstance is a strong indication that the children are suffering from the results of a remote syphilitic infection in one of the parents. The physical examination may show nothing definite, and yet the Wassermann reaction prove positive.

Cases of late malnutrition, non-syphilitic in character, due to poor hygiene and faulty feeding, may present symptoms identical with the above, so that while the two conditions cannot be differentiated by the clinical signs, there may be sufficient grounds for suspicion to warrant us in questioning the father, whereupon the history of a primary sore with perhaps secondary lesions may be elicited. There may have been prolonged treatment, with a subsidence of all the symptoms, and the patient may have been pronounced cured and told that he might safely marry. Many times this story is heard when the evidence of transmission is before the physician in the form of a typical case of congenital syphilis.

**Treatment** of tardy malnutrition of syphilitic origin by the supportive and restorative methods used in the cases of non-syphilitic malnutrition is without avail. (See Tardy Malnutrition, p. 146.) These patients require mercury, either alone or combined with the iodids. To the usual methods of treatment with iron, cod-liver oil, baths, and massage, there will be but little response, but if bichlorid of mercury or the iodid of potash be added, the case will improve. The improvement is slow, to be sure, but it is invariable. The child should be given the advantage of an outdoor life, with free ventilation of the sleeping-room at night. The food should be highly nutritious, containing a large amount of protein. Eggs, meat, milk, and the high-protein cereals, such as oatmeal, are the most valuable. The dried legumes—peas, beans, and lentils—given in the form of purées, are a valuable addition to the diet. Brine baths (p. 843) at bed-time during the entire year, followed by oil inunctions during the cooler months, are valuable in restoring a vigorous condition. As these children are almost always anemic, it may be well to combine the bichlorid of mercury with nux vomica, iron, and quinin. For a child from five to ten years of age the following prescription has been used with marked benefit:

R. Hydrargyri bichloridi.....	gr. ss
Tincturæ nucis vomicæ.....	gtt. xc
Extracti ferri pomati.....	gr. x
Quininæ bisulphatis.....	ʒj
M. Div. et ft. capsulæ No. xxx.	
Sig.—One capsule after each meal.	

This is given for ten days, when the bichlorid of mercury in tablet form, 1/60 grain three times daily after meals, is substituted for ten days. During the ten days when the bichlorid is given alone maltine and cod-liver oil may be given—1 dessertspoonful three times a day after meals. In these cases iodid of potash is not to be given early in the treatment, for the reason that the appetite is usually poor or indifferent, and the administration of the drug at this time might further decrease the desire for food. Syrup of the iodid of iron may be used in doses of 10 to 15 drops, three times daily, if the physician desires to change the form in which the iron is administered.

*Duration of Treatment.*—Prolonged treatment will usually be required. These patients should be kept under close observation for at least two years, or until they arrive at adolescence, when, as has been stated, they should be made acquainted with the nature of the disease. During the entire growing period the administration of mercury during one month out of every three, or possibly every six, depending upon the child's condition, will insure better growth and a more vigorous development both physically and mentally.

### TUBERCULOSIS

Tuberculosis is the condition resulting from an invasion of the body by the tubercle bacillus.

The subjects of *pulmonary tuberculosis* and *tuberculous cervical adenitis* have been discussed in previous sections (pp. 394 and 458).

**Types of the Infection.**—There are two types of the bacillus—the *human* and the *bovine*. In 132 cases of children between the ages of five and sixteen years Park and Krumweide<sup>1</sup> found the bovine type in 33 cases. In 20 of these there was a tuberculous cervical adenitis, in 7 abdominal tuberculosis, and in 3 generalized tuberculosis. Alimentary origin of generalized tuberculosis was apparent in 1, tuberculosis of the bones and joints in 1, and tuberculosis of the tonsil in 1.

The percentages of bovine infections were as follows:

	Children five to sixteen years, per cent.	Children under five years, per cent.
Pulmonary tuberculosis.....	0	0
Tuberculous adenitis (cervical).....	37	57
Abdominal tuberculosis.....	50	68
Generalized tuberculosis.....	40	26
Tuberculous meningitis, with or without localized lesion	0	0
Tuberculosis of bones and joints.....	3	0

Of 220 children infected under five years of age, 59 showed the bovine type. Of these, 20 showed tuberculous cervical adenitis; 13, abdominal

<sup>1</sup> Park and Krumweide: The Relative Importance of the Bovine and Human Types of Tubercle Bacilli in the Different Forms of Tuberculosis, Research Lab. Dept. Health, New York City, Jour. Med. Research, 1912.

tuberculosis; 10, generalized tuberculosis—alimentary origin; 5, generalized tuberculosis; 8, generalized tuberculosis including meningitis—alimentary origin; 1, generalized tuberculosis including meningitis; 2, tuberculous meningitis.

Park and Krumweide concluded as follows: "In children, the bovine type of tubercle bacillus causes a marked percentage of the cases of cervical adenitis leading to operation, temporary disablement, discomfort, and disfigurement. It causes a large percentage of the rarer types of alimentary tuberculosis, requiring operative interference or causing the death of the child directly or as a contributing cause in other diseases.

"In young children it becomes a menace to life and causes from  $6\frac{1}{3}$  to 10 per cent. of the total fatalities from this disease."

The bovine infection is largely limited to children, and the fatal cases are further limited to infants and very young children.

A review of the very extensive literature that now exists on this subject leads one to the conclusion that about 20 per cent. of the cases of tuberculosis in children are of bovine origin. (See p. 459.)

**Avenues of Entrance.**—Tubercle bacilli may enter the body by means of the respiratory and alimentary tracts, by means of the genito-urinary system, and through the skin. The two latter are very unusual modes of entrance. The avenue of entrance of the bovine bacillus is the alimentary tract—that of the human type, the respiratory tract. In a large majority of our cases the patient had been in association with a tuberculous individual.

*Illustrative Cases.*—Two children, aged six and eight, developed pulmonary tuberculosis. They were dispensary patients, and lived in a small three-story tenement house. The fact that the 2 cases developed at the same time seemed conclusive evidence of a common source of infection. Both the father and the mother were well, and they, with their 2 children, composed the family. Upon further investigation it was found that the janitor of the tenement had advanced pulmonary tuberculosis, and that he was not at all careful where he deposited tuberculous sputum.

Aged people with chronic bronchitis are often carriers of the tubercle bacillus, and such persons are the most dangerous. They remain indoors and infect the rooms. Not suspected of being tuberculous, they are careless, they kiss and fondle, and often assume considerable care of the younger members of the family. Several cases of tuberculous meningitis have been personally traced to such origin.

*Illustrative Cases.*—In a recent case the infection was traced to the grandfather whom the child visited for four weeks.

A baby of nine months, an only child, died from tuberculous meningitis. No source of the infection could be discovered until, six months later, the mother developed acute pulmonary tuberculosis of a very active type. She undoubtedly was suffering from latent tuberculosis at the time of the child's death. The father contracted the disease apparently from his wife, and died in two years. In all these cases there was a decidedly virulent infection.

**Predisposing Causes.**—Among the predisposing causes age is important. The more tender the age, the greater the susceptibility. Any illness which decreases the general resistance or lessens the resistance of the upper air-passages or lungs, predisposes to the disease. Thus we see many cases following measles, whooping-cough, scarlet fever, influenza, and bronchopneumonia. Adenoids and diseased tonsils are

eminently predisposing causes, particularly favoring tuberculous cervical adenitis. Heredity is less a factor than is generally supposed. Often what passes for heredity is a direct infection from a tuberculous parent, in whom the disease has remained dormant in the bronchial glands or elsewhere, and does not develop until a late period.

The close housing of children during the colder months is of no little importance as a means of diminishing resistance to tuberculosis. The habit of frequent change of residence is also a source of infection. A family moves into an apartment or tenement with little thought or knowledge of the previous occupant, and the owner makes no effort at painting or cleaning for the new tenants, carrying out only such changes as are absolutely necessary. Tuberculosis has been known to develop in children occupying an apartment in which a tuberculous adult had previously been domiciled. Infection may rarely take place through the blood of the mother by way of the placental circulation. Cases have been reported in our country by Jacobi and Wollstein, in which a tuberculous fetus has been born to a tuberculous mother.

**Prophylaxis.**—The best insurance against tuberculosis is a vigorous bodily resistance. At least 85 per cent. of the human race are infected some time before the thirtieth year, but, fortunately, the great majority of those infected are able to withstand the invasion. Observation with the von Pirquet test in different countries, covering a large number of children of varying ages, shows that from 40 to 70 per cent. react positively. The results demonstrate that a vast majority of the human race are infected before the fifteenth year. Adenoids and diseased tonsils should be removed from every child who possesses them. Children should be allowed to make complete recoveries from bronchitis, bronchopneumonia, influenza, whooping-cough, measles, etc. A week or longer from school is a matter of no moment in the child's future from the standpoint of knowledge. Kissing of children on the mouth should be forbidden. This act is a grossly unfair advantage to take of an innocent child. Overwork at school, in mines, and in factories predisposes by fostering close associations and diminishing resistance.

The reporting of tuberculous cases, and the rigid enforcement of hygienic measures relating to the disposal of tuberculous sputum, would materially lessen the number of cases.

Infants and young children up to the fourth year are very susceptible to tuberculosis. During this period the child should have absolutely no association with an active case in an adult or older child. If there is such an association the infant will in all probability develop tuberculosis.

**Milk Infection.**—The infection of the bovine type is preventable by pasteurizing all milk and butter which is not taken from tested cows proved free from tuberculosis. The nutritive qualities of milk are not harmed by heating, but all children fed on pasteurized milk should be given orange juice.

**Relative Frequency in Different Sites.**—Although the tonsil is looked upon as a portal for the frequent entrance of the disease, this organ has been found tuberculous in comparatively few instances.

In 90 per cent. of all cases of tuberculosis lymphadenitis the cervical

glands are involved, and chronic inflammation in these glands, when well advanced, is usually aggravated by the presence of infecting organisms of the staphylococcus or streptococcus groups.

Still has reported important findings in 216 postmortem examinations following fatalities from tuberculosis in children. In 63.8 per cent he traced the incidence of the disease to the lung; in 29.1 per cent. to the intestine; and in 15 of the 216 cases, to the ear. By other authorities the frequency of primary respiratory infection has been estimated at 65 to 70 per cent., and that of an initial intestinal infection at 15 to 30 per cent.

Both Still and Carr have reported finding caseation of the mediastinal glands in 81 per cent. of autopsies on tuberculous subjects, while in a proportion ranging approximately from 55 to 60 per cent. the same observers found a similar condition in the mesenteric glands. The mediastinal glands on the right side are more frequently diseased than those on the left.

Nearly 60 per cent. of tuberculous cases have shown invasion of the mesenteric glands; and in 12 of 100 autopsies upon children under two years of age Still found tuberculous peritonitis.

#### ABDOMINAL TUBERCULOSIS (TUBERCULOSIS OF THE MESENTERIC GLANDS; TABES MESENTERICA)

Tuberculosis of the mesenteric glands is not uncommon in the findings at autopsy upon young tuberculous subjects. Rarely is the condition sufficiently developed, in this country, to be recognized clinically independent of peritonitis.

The senior author's first postmortem examination upon a child, however, was in a case of this character. The patient was three months old, colored. In 2 other cases autopsy showed uncomplicated tabes mesenterica with no peritonitis. The condition in 3 other cases was diagnosed as true tabes mesenterica.

**Symptoms.**—The symptoms include slow progressive emaciation, slight inconstant elevation of the temperature, distended abdomen, persistent intestinal indigestion, diarrhea, flatulence, and abdominal pain. The pain is colicky in character, and may be very severe and continue over a considerable period.

**Diagnosis.**—A positive diagnosis is to be made upon one's ability to palpate the enlarged glands. For critical abdominal examination one must often employ light anesthesia, as this renders the examination far more satisfactory. The glands are often best felt in the right or left iliac fossa.

The symptoms somewhat resemble those of chronic appendicitis, and a rectal examination may be necessary to determine if there is an enlargement of the appendix or adhesions or infiltration about it.

Celiac disease upon superficial examination is readily confused with abdominal tuberculosis.

**Prognosis.**—The prognosis is unfavorable in cases that have developed sufficient signs for a diagnosis. Still, who has had a large experience in abdominal tuberculosis, has stated that we are never sure of the recovery cases. The diseased glands may at any time be the starting-

point of a general or localized inflammation, with the output of extensive adhesions resulting in a general tuberculous peritonitis or producing local effects interfering seriously with the functions of the intestine.

*Illustrative Case.*—Some years ago the writer performed an autopsy for a colleague on a two-year-old child who had died suddenly with symptoms of acute intestinal obstruction. The child had had abdominal trouble during the second year, and had been seen by different physicians, one of whom made a diagnosis of *tabes mesenterica*. The patient improved and three months previous to the fatal termination was well, except for obstinate constipation. The postmortem showed a most remarkable picture of enlarged glands matted together by fibrinous exudate, which had been poured into the abdominal cavity and had undergone connective-tissue formation. The descending colon resembled a hollow tube held in position by the surrounding exudate. How the child had lived and had bowel evacuations is difficult of explanation. The obstruction was caused by an angle forming at the point where the free intestine, filled with gas, joined the fixed portion.

**Treatment.**—All measures that will increase the patient's resistance should be employed. An out-of-door life and the general management advised in treating other forms of tuberculosis (p. 397) should be followed.

Still believes that operative measures are of value. He has found that removal of the enlarged glands is to be advised, as thereby eliminating a definite focus of infection. At the same time fibrinous bands causing pain and other symptoms may be broken up.

#### CHRONIC TUBERCULOUS PERITONITIS

Acute tuberculous invasion of the peritoneum may be found in a few cases of general tuberculosis. It is of no clinical significance, and is briefly referred to below under Pathology.

Chronic tuberculous peritonitis is a comparatively infrequent disease in this country. In England and on the Continent many more cases are seen. Still reported 266 fatal cases of tuberculosis in children under twelve years of age, 45 of whom died with tuberculous peritonitis—a percentage of 16.8. Under two years of age this author found 12 cases of tuberculous peritonitis in 100 tuberculous infants.

**Age.**—The great majority of cases occur between the first and third years. Cases developing before the end of the first year are rare.

**Etiology.**—A considerable proportion of the cases are probably due to an extension from infected mesenteric glands. Through the lymph and blood-channels the bacilli may be carried to the peritoneum from any focus.

*Types of Bacilli.*—Park and Krumweide found the bovine form in 20 of 53 cases of tuberculosis between the fifth and sixteenth years. In 35 children under five years the bovine bacillus was present in 20 cases.

**Pathology.**—The course of the inflammation may be acute or chronic, and the changes produced have given rise to a classification of several types of the disease.

1. The simplest lesions consist of scattered grayish miliary tubercles unassociated with the presence of exudate or other evidences of an advanced process. This picture is seen in connection with a general miliary tuberculosis which may have presented no local clinical signs.

2. In a second form of the disease, coexisting with miliary tubercles which are scattered over the peritoneum in great number, there is a marked ascites depending on the predominance of the element of exu-

dation. The exudate is serous and contains only a moderate amount of fibrin. When the fluid accumulation is large the intestines are floated up and the abdominal cavity is characteristically distended.

3. A third variety of tuberculous peritonitis is predominantly adhesive and unaccompanied by the exudation of much fluid. The loops of intestines become closely matted together and the omentum is rolled up in a firm elongated mass. The typical tubercles are present, but have, at many sites, become confluent and been transformed into larger foci, or given way to the development of reparative fibrous tissue. The amount of fluid exudate is small and may be clear or clouded by the admixture of fibrin and flakes of pus.

4. Finally, the lesions may be of a destructive character, consisting of actual ulcerations caused by the disintegration of large caseous foci. In such an event adhesions between intestines, mesentery, and omentum are produced which serve to confine collections of pus. These may eventually break forth and discharge externally. Fecal fistulæ or abscesses between adjacent portions of intestine are not uncommon.

**Types of Lesions.**—The disease is usually divided pathologically into two leading forms—the *ascitic* and the *plastic* or *fibrous*.

There are few cases of the fibrous type, however, without fluid in the abdomen, and few ascitic cases in which there is not some fibrous formation. Still found the proportion of the fibrous to the ascitic type 10 to 1.

**Symptoms.**—Suggestive symptoms in all cases are abdominal discomfort, pain, and distention from gas or fluid, digestive disturbances, emaciation, and persistence of all symptoms in spite of medication and careful dieting.

*The Ascitic Type.*—In the ascitic form, when the patient first comes under observation, the abdomen usually contains considerable fluid. This increases rapidly and the abdominal wall becomes distended and tense.

There may be a temperature of 100° to 102° F. An elevation of the temperature is, however, not invariably present; it is as often absent. There is a secondary anemia, and the child becomes emaciated and tires readily. A differentiation, however, between tuberculous ascites and that due to other causes may not be possible without corroborative evidence of tuberculosis elsewhere. Examination of the ascitic fluid even in positive cases does not always show the presence of the tubercle bacilli. Through absorption of the fluid, cases that belong to the ascitic type at first, change to the fibrous. This phenomenon is not at all unusual.

*The Plastic Type.*—In these cases the onset is gradual, the temperature usually is not high—100° to 101° F. There is loss of appetite with emaciation. Intestinal indigestion, evidenced by tympanites and occasional diarrhea, is common. There may be constipation alternating with diarrhea, and there is almost always pain. It is the pain that usually attracts the attention of the parents to the child's condition. The course of this form of the disease is slow and its progress may be interrupted by periods of improvement.

Figures 133 and 134 are reproductions of the x-ray plates made from a case in which tuberculous peritonitis was associated with pylorospasm.

The case well illustrates how the inflammatory process may lead to symptoms of mechanical origin.

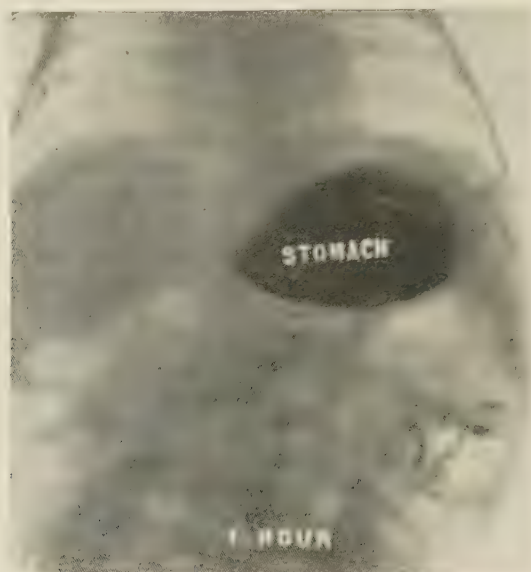


Fig. 133.



Fig. 134.

Figs. 133, 134. —Tuberculous peritonitis associated with pylorospasm (Kerley and Le Wald, *Digestive Disturbances in Infants and Young Children*).

Male, aged four and a half months. Family history negative for tuberculosis. When patient was four days old a right inguinal hernia was noticed. At seven weeks, 30 c.c. of fluid removed from a left hydrocele; three weeks later, 30 c.c. again withdrawn. Suffered from convulsions, regurgitation of food, and constipation.

*Roentgen Examination.*—One hour after an opaque meal only a trace had gone through the pylorus, suggesting either a pyloric stenosis or a spasm (Fig. 133). The fact that the stomach had almost completely emptied itself in four hours and twenty-five minutes led to diagnosis of spasm which had evidently relaxed after the one-hour plate. Distinct delay in the small intestine which appeared dilated. Five hours after the meal distended loops of ileum were prominently outlined (Fig. 134). Roentgen diagnosis: Tuberculous peritonitis.

Delay of the bismuth in the small intestine is very suggestive of tuberculous peritonitis. This delay is evidently due to adhesions which are almost invariably present. In addition, there is very apt to be pouching of the small intestine for the same reason.

*Operation.*—Free fluid in the peritoneal cavity and numerous tubercles on the peritoneum. Small intestine adherent to the abdominal wall in a number of places; hence the impossibility of freeing the loops without danger of perforation. Operative diagnosis: Tuberculous peritonitis.

**Diagnosis.**—It is rare in cases of the fibrous type or in those due to mesenteric lymphadenitis not to find nodules in either of the iliac fossae or the evidence of fibrous bands in the abdomen. The retracted, thickened omentum, forming a distinct ridge across the abdomen, is present in many cases. This may be confused with the lower edge of the liver. Careful palpation, however, will demonstrate the band as thick and roughened, and extending well across the abdomen in a downward direction toward the left side. A space between the band and the lower edge of the liver can usually be made out.

With the palpable mesenteric nodes or the fibrous bands there will be fluid in some amount. An unfolding of the umbilicus, with redness about it, producing a condition known as "pouting," is a suggestive symptom. Perforation at this point is not an uncommon occurrence in the experience of those who see many cases of this disease.

**Prognosis.**—About one-half of the patients recover. Pronounced cases may go on to complete recoveries. It is a difficult matter, however, as in the instance cited, to decide when a patient is well. The cases with ascites promise better than do those of the fibrous type; and yet many of the latter form which promise little make complete recoveries.

*Illustrative Case.*—A boy three years old developed tuberculous peritonitis of a pronounced fibrous type. The omental band could be seen elevating the skin across the abdomen in a distinct ridge. After several months of treatment improvement began, and there was steady progress toward a betterment until the bodies of the two upper lumbar vertebrae became involved. The child made a complete recovery eventually from both conditions.

**Treatment.**—The hygienic and medical management is similar to the treatment outlined for other cases of tuberculosis (p. 397). Adequate rest, high-protein diet, open air, and change of climate, when this may be supplied, should be provided. Drugs are of value only as a means of improving nutritional conditions. A combination which seems to possess real value in these cases is the following:

For a child three years of age:

R <sub>x</sub> .	Liq. potassii arsenitis.....	℥xlviij
	Liq. ferri albuminati.....	℥vj
	Syr. hypophosphitum (calcis et sodæ).....	q. s. ad. ℥vj

M. Sig.—One teaspoonful in water after meals.

The medication is given for ten days, then omitted for five days, and then resumed. Interrupted medication may be continued in this way indefinitely.

Moderate exercise may be allowed if the temperature is normal.

*Operation.*—There appears to be but little unanimity of opinion as regards the advisability of operative procedure in tuberculous peritonitis. Some authors are ardent advocates and give statistics to prove their contentions; on the other hand, other physicians, with equally large experience, disapprove of the operation. A logical course is as follows: If there is marked ascites with much discomfort, interfering with respiration and heart action through pressure on the diaphragm, operation is to be advised at once. It would seem that early operation furnishes the best chance for relief in the acutely active cases. Evidence of interference with normal peristalsis, as indicated by persistent constipation and visible peristalsis, means that intestinal obstruction is imminent, and under such conditions immediate laparotomy is advised. When the above conditions do not obtain it is advisable to postpone operation, and treat the patient along the lines already defined.

Some of the cases seen are absolutely hopeless at the time, showing marked tuberculous processes elsewhere, and therefore are not considered fit for operation.

The patient should be weighed once a week. In case of a continuous loss in weight and strength extending over five or six weeks, with or without fever, in spite of the advantage of diet, climate, and medication, operation is to be advised, regardless of the stage of the process, providing always that there is no active tuberculous process elsewhere. When the weight remains stationary or nearly so, and there is no evidence of advance in the abdominal lesions, it is safe to wait for a considerable time before undertaking operative measures.

*Heliotherapy in Surgical Tuberculosis.*—In the summer of 1912 Dr. Rollier, of Lysin, Switzerland, published his results in the treatment of surgical tuberculosis at the tuberculosis congress in Rome. In the town of Lysin are situated, on the snow-covered mountain, the pavilions where his method of heliotherapy is practised. It consists in exposing the body of the patient to the sun's rays in open galleries communicating with the wards and facing due south. The actual seat of disease is uncovered for five minutes only, to begin with, as there must be no blistering or burning of the skin; the next day the region is treated for two periods of five minutes each, separated by an interval of half an hour; and on the third day these exposures are lengthened to fifteen or twenty minutes. At each séance a larger area of skin is exposed, so that at the end of two weeks the entire body, except the head, is being exposed to the rays of the sun. The head usually requires protection for a little longer time so as to prevent congestion. Plaster jackets are rarely used, while abscesses are aspirated and exposed in the usual manner. In the jackets windows are cut so that portions, at least, of the body are exposed.

Improvement is evinced almost immediately. Fever disappears, hemoglobin and red cells approach and attain their normal standards, while increase in weight is most noticeable. Out of 369 cases of surgical tuberculosis treated thus, in 284 (78 per cent.) recovery was obtained; in 48, improvement; in 21 the condition remained stationary, while 16 (4 per cent.) terminated fatally. In visceral tuberculosis the results were excellent. In 27 cases of peritonitis and enteritis there were 17 recoveries,

3 improvements, and 3 deaths. Certainly no other treatment has given such results.

The different rays (blue, indigo, violet) each play a part in the curative process as well as the more recently discovered infra-red and ultra-violet rays. Some are analgesic, some have a tonic action, and others penetrate deeply into the tissues. There is no attempt to utilize any particular ray as Finsen did. Experiment has shown that fully 25 or 30 per cent. of sun's rays are absorbed by atmosphere and dust and that to make the treatment efficient altitude is of prime importance.<sup>1</sup>

#### TUBERCULIN SKIN REACTIONS

In a study of 650 hospital cases Dr. Alan Brown<sup>2</sup> found that 70 per cent. of the cases under two years of age giving a positive reaction proved fatal. The lesions were, with but rare exceptions, general in distribution.

That infants show a high degree of susceptibility to tuberculosis was shown by the fact that of 61 infants in whom a definite history of exposure could be obtained, 41 responded to the test, and of these, 37 died of tuberculosis.

In infancy a negative cutaneous reaction, except in moribund cases or in children suffering from any very acute infection, is almost conclusive evidence against the existence of a tuberculous focus.

Among 100 consecutive cases of tuberculosis, 95 gave a positive reaction, the remaining 5 patients being moribund on admission to the hospital.

In a child in whom tuberculosis is suspected the test should be repeated if at first it proves negative.

CHART SHOWING THE HIGH DEGREE OF MORTALITY IN INFANTS RESPONDING TO THE CUTANEOUS TEST. ALL FATAL CASES PROVED TUBERCULOUS EITHER BY AUTOPSY OR THE FINDING OF BACILLI IN SPUTUM OR CEREBROSPINAL FLUID

Age.	Number of cases.	Number with positive reaction.	Number of positive cases with autopsy or bacteriologic examination.	Number of positive cases proved to be tuberculous by autopsy or bacteriologic findings.	Number of negative cases that came to autopsy.	Number of negative cases which showed no tuberculosis at autopsy.
1 to 3 months . . . . .	62	3	3	3 or 100 per cent. of + reactions.	10	10
3 to 6 months . . . . .	102	7	6	6 or 85 per cent. 35	13	13
6 to 12 months . . . . .	218	43	35	35 or 81 per cent.	19	18 Test not re- ported in one case.
12 to 18 months . . . . .	156	37	20	20 or 54 per cent.	15	15
18 months to 2 years . . . . .	112	24	15	15 or 62 per cent.	4	4
Total, 0 to 2 years . . . . .	650	114	79	79 or 70 per cent. of + reactions.	61	60

<sup>1</sup> Cf. Rollier, Heliotherapy, 1923.

<sup>2</sup> Archives of Pediatrics, July, 1913.

CHART SHOWING THE BEARING OF EXPOSURE TO TUBERCULOSIS ON THE MORTALITY IN THE INFANT

Age.	Number of cases.	Number of cases with a definite family history.	Number of cases with definite family history that reacted.	Mortality of cases with definite family history that reacted.
1 to 3 months.....	62	4	3	3
3 to 6 months.....	102	8	4	4
6 to 12 months.....	218	30	20	20
12 to 18 months.....	156	10	10	6
18 months to 2 years.....	112	9	4	4
Total, 0 to 2 years.....	650	61	41	37 or 60 per cent. of those giving a history of contact.

In a statistical study of tuberculin tests Wahl and Gerstenberger<sup>1</sup> were able to establish the following:

"A study of the tuberculin tests performed upon exposed, suspicious, or actively tuberculous individuals of the clientele of the Babies' Dispensary and Hospital of Cleveland from the year 1907 to September, 1921, showed the following findings:

"1. A slight increase of positive tests in the females over the males, the former giving a positive percentage of 61 per cent. and the latter a positive percentage of 54.

"2. An increase in the percentage of positive reactions corresponding with the increase in age, being 35 per cent. in infants under six months of age, and 87 per cent. in young children between thirty-six and forty-eight months of age.

"3. Of the different races and nationalities, the colored race gave the highest percentage of positive reactions.

"4. Patients exposed to two or more sources of tuberculous infection showed a higher percentage of positive reactions than those exposed to only one.

"5. When only one source of contact existed for a patient, the mother was found responsible for the highest percentage of positive reactions, a brother or sister for the next highest, and the father for the lowest of the group.

"6. Children giving a negative history of exposure showed only 15 per cent. positive reactions as against 44 per cent. for those having a positive contact history. In other words, 44 per cent. of the children giving positive tuberculin tests gave a definite history of tuberculous contact, whereas, of those giving a negative history of exposure only 15 per cent. reacted positively.

"7. Scrofula gave the highest percentage of positive reactions and was followed by pulmonary tuberculosis, tuberculous adenitis, tuberculous osteomyelitis, tuberculous meningitis, and pulmonary miliary tuberculosis.

"8. By using the intracutaneous test, controlled by checking with a known case of tuberculosis, a higher percentage of positive reactions can be obtained, especially in cases of tuberculous meningitis and pulmonary miliary tuberculosis, than has been usually reported.

<sup>1</sup> Arch. Pediatrics, xl, 3, March, 1923, pp. 143-150.

"9. The intracutaneous tuberculin test, 0.1 c.c. of a 1 : 100 solution, is in practically 100 per cent. of the cases more sensitive in its reaction than the tuberculin tests performed either with the 'tattoo' or the 'burr' methods. Likewise, the test performed by the 'tattoo' method is more sensitive than the 'burr,' although the former is more difficult from a technical standpoint.

"10. The intracutaneous test with a 1 : 1000 solution has always been found positive even when stronger dilutions of 1 : 10 and 1 : 100 were used. The reactions with the stronger solutions have been in general more marked, but the reaction with the 1 : 1000 dilution has been sufficient to convince us to choose it as our standard in performing the intracutaneous test routinely."

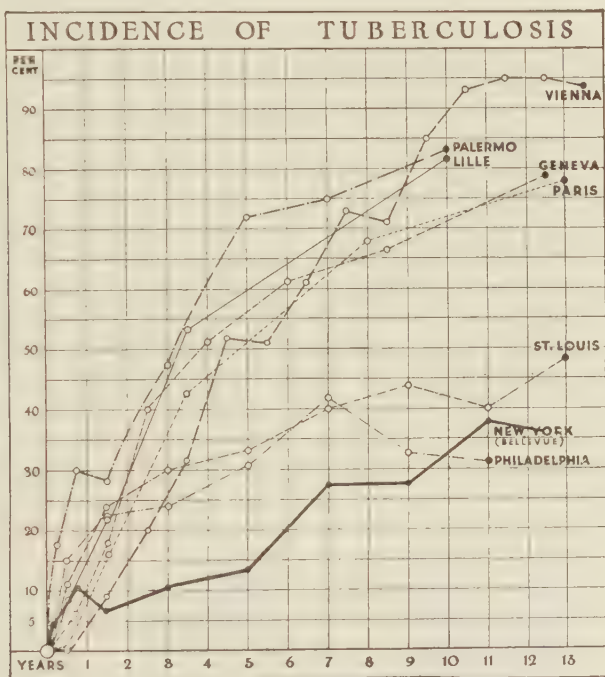


Fig. 135.

A fairly accurate idea of the incidence of tuberculosis in different cities may be gained from a study of the above chart (Fig. 135), which is taken from a report by Smith.<sup>1</sup>

"Incidence in cities of infection with tuberculosis, as shown by percentage of positive skin reactions. Upper curves represent series reported from European cities and all show a higher percentage of positive reactions than in American cities. The New York series represents about 1500 consecutive cases in the wards of Bellevue Hospital, Children's Medical Division. In this series the Pirquet and intradermal reactions were done on all cases, and nearly all the negative cases were retested with

<sup>1</sup> Tuberculosis in Childhood by Charles Hendee Smith, Bulletin of New York Tuberculosis Association, March to April, 1923.

increased doses of tuberculin. The children were all under continuous observation and the reactions were read daily for five to ten days so that the possible error due to reading was practically eliminated."

The tuberculin reaction is discussed in further detail with mention of results obtained in the use of the intradermal method on pp. 824-826.

#### DACTYLITIS

Dactylitis is characterized by a fusiform swelling of one or more of the phalanges. (See Fig. 136.) There are two forms—*dactylitis syphilitica* and *dactylitis tuberculosa*.



Fig. 136.—Dactylitis.

**Pathology.**—The lesion is the same in both types, consisting of rarefying osteomyelitis. The process begins in the center of the bone, caus-

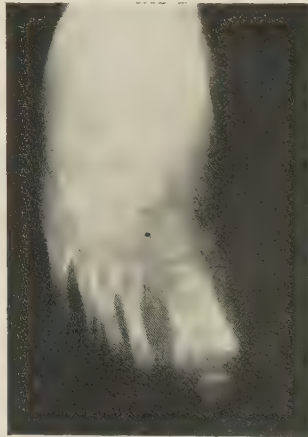


Fig. 137.—Tuberculous dactylitis of the first metatarsal. (Bellevue Hospital.)

ing an enlargement of the medullary canal. At the same time, particularly in syphilitic types, there is a periostitis with deposit of bone cells, so that

eventually the bone is of much greater circumference than other similar bony parts.



A, Necrosis in first phalanx, middle and little fingers. B, Ten weeks later. Bone structure partially re-established. C, Eventual complete restoration to normal.

Fig. 138.—Radiograph of hands in tuberculous dactylitis.

Suppuration and necrosis occur. A mere shell of bone may remain which, on undergoing further necrosis, may result in the loss of the finger or toe. The disease does not limit itself to one bone.

*Illustrative Case.*—In a syphilitic case all the fingers of both hands were involved and also the metatarsals of both great toes. The index- and middle fingers of the right hand suffered most. On the whole, both hands were alike and appeared almost webbed, due to the swelling of the proximal phalanges, while the distal phalanges tapered in a definite penciled fashion. There was apparently no pain, and the infant used the hands with perfect freedom. The *x*-ray plates showed a destructive osteitis involving the bones of both hands.

The radiograph reproduced in Fig. 138 shows very graphically the bone change taking place in tuberculous dactylitis. The patient, a child of eight months, had the advantage of heliotherapy.

**Differentiation** between the two types from the clinical appearance is impossible. When the lesion is multiple, it is more apt to be of syphilitic origin, although this is by no means certain. The tuberculin test and the Wassermann reaction, in the absence of disease elsewhere, will be required to establish the diagnosis, as the symptoms and appearance are identical in both forms.

**Treatment.**—Aside from the antisyphilitic treatment, the management of the two types is the same. Absolute rest of the parts appears to be essential for success. This is best secured by the use of splints, which must be kept bound on the fingers for months in such a way as effectually to immobilize them. In a case of the tuberculous form, successfully treated in this way, the finger was kept in splints for six months. When abscess and necrosis occur, the case must be treated along surgical lines, the immobility of the parts being maintained as completely as the conditions allow.

## XX. DISEASES DUE TO DISTURBANCES OF METABOLISM

### ACIDOSIS (KETOSIS)

ACIDOSIS is a condition in which there is diminution of the alkali reserve of the body fluids, especially of the blood, usually attended by an excessive formation of acids with its resulting clinical symptoms.

**Etiology.**—An alteration of the equilibrium and normal relationship of the alkalies and acids in the body is the direct exciting cause. The blood, in order for life to exist, must be maintained at a very constant reaction which is slightly alkaline, and there must be, within narrow limits, a certain excess of bases over acids. Any change from the normal toward the side of acidity tends to inhibit numerous sensitive metabolic processes in the organism, and acidosis results.

(For the specific etiologic factors tending to induce acidosis see p. 774.)

**Pathogenesis.**—Metabolic products, especially carbonic acid, are constantly being formed in the tissues and poured into the blood to be transferred to the lungs for elimination. This would tend to alter its normal slightly alkaline reaction to one strongly acid were it not for the alkali reserve formed by bicarbonates both in the blood and tissues, by the alkaline phosphates of sodium and potassium, and by the alkali-yielding proteins, in conjunction with efforts of elimination by the body. The slightest change in the direction of acidity is sufficient to stimulate the respiratory center through the agency of the carbon dioxid contained in the blood. The increased pulmonary ventilation removes the excess of carbon dioxid and the blood returns to its original state, as the respiration lowers the concentration of carbon dioxid in the lungs and thus allows it to pass from the tissues where it is in greatest tension to the blood and thus to the lungs where the tension is lowest. Certain non-volatile acids, as sulphuric and phosphoric, also cause, when formed, increased pulmonary ventilation and hyperpnea, as they remove some of the alkali reserve of the blood, thus leaving more of the carbonic acid, normally produced by the tissues, to be eliminated through the lungs. These acids are for the most part eliminated through the kidneys which have the power to excrete an acid urine from a practically neutral fluid, leaving behind an alkali reserve for further neutralization purposes. An interference with the elimination of acids as well as their overproduction may therefore cause acidosis. A final and very efficient means of preserving the alkaline balance lies in the ability of the body to form the alkali, ammonia, from urea, a neutral substance, which thus adds greatly to the alkali reserve.

**Symptoms.**—Acute acidosis in children usually manifests itself in two forms: as a *peculiar symptom complex* seen in infants, and in *recurrent or cyclic vomiting* of older children. In the former, hyperpnea is one of the earliest and most constant symptoms. The majority of cases occur in infants who are of the marasmic type, or suffer from malnutrition

and who have finally a severe attack of diarrhea, following a digestive disturbance. The hyperpnea is associated with an ashen gray color of the skin and a peculiar pallor, but no cyanosis. The lips are cherry red. At first there is great irritability and restlessness which is succeeded by a condition of stupor and eventually coma. The eyes become deeply sunken and staring, and the mouth and lips dry and parched, the fontanelles are depressed, and the respirations are of a deep and sighing character, without pause and usually labored. On being aroused from the stuporous state the child shows marked irritability, crying as though in pain. The temperature curve shows marked fluctuations, not usually going above 101.5° F. A polymorphonuclear leukocytosis ranging from 10,000 to 20,000 is found. A very scanty excretion of urine often amounting to anuria often obtains. The stools are usually abundant and of a watery consistency. Determinations upon the expired or alveolar air show a marked reduction in the carbon dioxid tension which may fall as low as 15 to 12 mm. of mercury from the normal of 35 to 45 mm. There is a great tolerance for alkalies, as much as five to ten times the usual amount being needed to bring about an alkaline reaction of the urine to litmus, and keep it alkaline for twelve or more hours. Acetone may not be found in the urine even in the most severe cases.

**Treatment.**—Alkalies must be given promptly, and in sufficient quantities to bring the blood back to the normal reaction. A 4 per cent. solution of sodium bicarbonate for intravenous use best answers the purpose, especially where rapidity of action is desired, and should be given in amounts of 15 to 20 c.c. per kg. of body weight. This may be repeated in three to four hours if the hyperpnea has not disappeared or if the alveolar carbon dioxid tension is as low as 25 mm. (See p. 829.) The superior longitudinal sinus or the external jugular vein in infants offers a very convenient avenue of administration. In older children the median basilic may be used. Sodium bicarbonate in doses of 20 to 60 grains should also be given by the mouth every two hours until the urine is alkaline to litmus.

Glucose in 10 per cent. solution administered by the bowel, or in extreme cases intravenously, in amounts up to 20 c.c. per kg. of body weight is the recognized easily available fuel with which deficient oxidation must be combated. To guard against excretion of this sugar in the urine the injections should be gradual. Such administration of glucose, even without alkali, tends to restore the normal alkali reserve of the blood.

In intestinal intoxication there is with the usual acidosis a marked increase in the non-protein nitrogenous constituents of the blood, and the symptoms resemble those of uremia. Schloss<sup>1</sup> has explained that the failure of the kidney in intestinal toxemia to preserve the acid-base equilibrium results from restricted formation of urine due to the dehydration so characteristic of the diarrheal disease.

As the activity of the kidneys is at a low ebb when acidosis develops, they should be stimulated by water or salt solution given freely by mouth, rectum, subcutaneously, intraperitoneally, or intravenously. "As much as 200 to 350 c.c. may be given at a single injection to a small infant."<sup>2</sup>

<sup>1</sup> Amer. Jour. Dis. Child., 15, 3, March, 1918, pp. 165-189.

<sup>2</sup> Howland and Marriott, *Abt's Pediatrics*, Vol. II, chap. xxviii, p. 841.

Schloss<sup>1</sup> has recommended the intraperitoneal injection of normal saline as the method of choice in the administration of fluid in severe intestinal intoxication cases. Fluid should be administered until the blood concentration is found to be normal by hemoglobin determination. Following this, as an adjunct of great value not so much for nutrition as to promote diuresis, he has given glucose in 10 per cent. solution, 20 c.c. per kg. of body weight. The administration of the saline before giving the glucose is particularly important, as a large amount of tissue fluid is necessary to insure the requisite withdrawal of fluid into the blood-stream. This treatment may be repeated in five or six hours.

(For *transfusion* of citrated human blood in acidosis see p. 777.)

### ALKALOSIS

Following the prolonged administration of bicarbonate of soda in excessive amounts typical tetany seizures culminating in convulsions have been observed in young infants and nephritics. According to Howland and Marriott<sup>2</sup> these manifestations ordinarily cease promptly on cessation of the dosage, but "when massive doses of sodium bicarbonate are to be administered there are theoretic as well as practical reasons for administering magnesium sulphate subcutaneously as a prophylactic against tetany. This may be given in 8 per cent. solution in doses up to 0.2 gm. per kg. of body weight." When it is not practicable to determine the bicarbonate reserve of the blood-plasma, these observers have recommended that the fresh urine be tested with a drop of cresol purple. "If the color remains green more alkali is necessary; if it changes to any shade of red or purple a sufficient amount of alkali has been given."

Greenwald,<sup>3</sup> in experiments with dogs, found that only in the tetany of hyperpnea is there indication of change in the reaction of the blood following prolonged slow administration of bicarbonate of soda; and "even in this condition the tissue anoxemia resulting from increased stability of oxy-hemoglobin rather than alkalosis *per se*, is the exciting factor."

From the rather meager evidence at hand it would thus seem that whereas excessive alkalization, particularly in cases of nephritis and pyelitis, may constitute a danger, nevertheless this danger is not great and may be readily avoided by careful clinical and laboratory observations in carrying out the treatment of acidosis cases.

### CYCLIC VOMITING (RECURRENT OR PERIODIC VOMITING)

By recurrent vomiting is understood the disorder which for a period of several months or longer is manifested by vomiting seizures at fairly definite intervals.

True cyclic vomiting or recurrent vomiting may be one of the manifestations of acidosis, p. 770. Children who suffer from dilatation and ptosis of the stomach (p. 221) often suffer from periodic vomiting, likewise those who have mechanical intestinal defects (p. 253) and chronic appendicitis. In these cases, however, the seizure is not prolonged and there is no air-hunger, no great prostration, and there are no fatalities.

<sup>1</sup> Boston Med. and Surg. Jour., September 21, 1922; New York State Jour. Med., August, 1918.

<sup>2</sup> Abt's Pediatrics, Vol. II, chap. xxviii, p. 840.

<sup>3</sup> Jour. Biol. Chem., liv, 2, October, 1922.

There may be acetonuria as there is in any other acute disorder in children, without diminished alveolar air tension. The nature of the seizure is quite apart from the vomiting of acidosis.

**Etiology.**—Children who have cyclic vomiting often show varying nervous phenomena, such as habit spasm, chorea, recurrent spasmodic croup, and spasmodic bronchitis. Rachford was the first to designate the underlying condition as a gastro-intestinal lithemia.

**Secondary Etiologic Factors.**—There are certain associated conditions which may precipitate an attack in a susceptible subject. Habitual constipation with defective elimination is present in some cases. In other cases there is an associated intestinal crisis, with vomiting, high fever, and a sharp diarrhea. In others the onset may be with grip, pneumonia, or one of the exanthemata. Fright, fatigue, and unusual excitement may play a part in inducing an immediate attack. Each of these factors, however, represents the spark that ignites the powder. If the condition of systemic intoxication did not exist, any of the influences mentioned would not produce the vomiting. Runyon reported 6 cases of recurrent vomiting cured by the removal of a chronically diseased appendix.

There are also seasonal influences. When the child can exercise and perspire, when he runs much and plays hard, elimination is better, and in many cases fewer attacks occur. Repeatedly, in getting the history of these cases one hears that there are no attacks between May and October.

**Symptoms.**—The vomiting periods occur periodically. In some cases observed the attacks occurred every nine days, in others but once in three or four weeks, or as many months. Each patient involuntarily arranges his own distinct periods, and usually fulfils the contract.

Prodromal symptoms have been unusual. Now and then a mother will state that she can anticipate an attack by some peculiar behavior on the part of the child—that he will lose his appetite or that the skin over the face will have a greenish or yellowish tint, or that the breath will be offensive.

The symptoms are very characteristic, and occur in no other condition. The child, without prodromal signs, has a sharp attack of nausea and vomiting. The nausea is extreme and the retching and straining occur at frequent intervals. There is often no elevation of the temperature. There may be, however, decided pyrexia early in the attack. In Rachford's experience an elevation of temperature is the rule in young children. There is marked prostration. The child becomes very pale. The eyes are sunken and the loss in weight is rapid. Acetone bodies are present in the urine. Neither food nor water is retained. The thirst is extreme. Eventually there is exaggerated sighing respiration, a true air-hunger. The patients beg for water, only to vomit as soon as it is given. The vomited material usually contains hydrochloric acid, while in true gastritis free hydrochloric acid is absent (Rachford).

The illness may last but a few hours, with one or two vomiting seizures. In the average case the duration is from three to five days. The longest case witnessed was that of a boy of three years who vomited persistently for thirteen days. In some cases the vomiting is sufficiently severe to produce hematemesis.

*Illustrative Case.*—A girl of eight years during an attack vomited such large amounts of blood that it was necessary to keep her under the influence of morphin given hypodermically.

*The Breath.*—During the attack the breath usually has the characteristic odor of acetone. This is a sweetish odor, not unlike that of chloroform. Observant mothers, in describing the child's symptoms, have referred to this sign without suggestion from the physician. Examination fails to show anything abnormal except the presence of acetone, diacetic acid, and oxybutyric acid in the urine, as described by Edsall.

In a mild or moderately severe case the vomiting stops abruptly and the child asks for food and retains it, providing reasonably simple food is given. In a few days he has made up the loss in nutrition and is as well as ever.

In more severe attacks the child may require several days to regain his usual health and vigor. The resumption of the feeding will necessitate considerable care.

**Differential Diagnosis.**—A first attack of cyclic vomiting may be confused with meningitis, acute indigestion, or the vomiting in acute nephritis, appendicitis, or intestinal obstruction. In the event of an abrupt onset in a first attack a diagnosis may not be made for a day or two. The differentiation laid down in some of the books is not dependable.

Thus the vomiting which occurs as the earliest symptom of tuberculous meningitis may be clinically identical with that of cyclic vomiting, and only by the appearance of other signs of meningitis or through lumbar puncture is the differentiation possible.

In acute indigestion there is a brief period of fever and one or two vomiting seizures, after which the patient is well. In acute nephritis an examination of the urine readily settles the diagnosis. In appendicitis there is pain and spasticity and the vomiting is not continuous; in cyclic vomiting the abdomen is relaxed, soft, and not tender. Intestinal obstruction is an affliction of infancy; cyclic vomiting rarely occurs before the second year, and usually not until after the third year. In intestinal obstruction, moreover, there is abdominal distention and perhaps the passage of bloody mucus, due to intussusception.

*Every child presented because of recurrent vomiting should be given the benefit of serial x-ray study of the gastro-intestinal tract.*

*Illustrative Case.*—A boy six years of age had had repeated attacks of severe recurrent vomiting at intervals ranging from six weeks to three months. In the last seizure he had lost 9 pounds in weight.

It was found upon x-ray study that the sigmoid was greatly elongated and that there was rectal stasis due to an overacting anal sphincter. In fact, the rectum was never empty. The mother, an unusually intelligent woman, was directed to insert her finger into the rectum after a fairly free evacuation had been induced by a mild laxative. Invariably there was found fecal material in considerable quantity behind the sphincter. Dietetic measures and stretching of the sphincter were sufficient to relieve the vomiting. In the ensuing two years there were no attacks.

**Prognosis.**—The prognosis is usually good not only as regards life, but as regards the continuation of the attacks. We have, nevertheless, seen a number of fatal cases.

**Treatment in the Intervals.**—In describing the management of children

who show the rheumatic complex, the influence of the sugar and fat was referred to. In the cyclic vomiting cases the precaution of withholding these substances from the diet is one of the most necessary features of the interval management. Different authors refer to the fact that the use of milk in some children is productive of attacks. It is the fat content of the milk that produces the attack. These patients may take fat-free milk and buttermilk without inconvenience. The diet prescribed for the cyclic vomiting case is that laid down on p. 739.

Milk-fat, sugar, and egg-yolks are forbidden.

*Medication.*—For a child from three to ten years of age from 9 to 12 grains of salicylate of soda, or aspirin may be given after meals daily in divided doses, for five days out of fifteen. During the ten days of rest from the salicylates 10 grains of bicarbonate of soda should be given twice daily after meals. This method of treatment must be continued for months. If the salicylate of soda interferes with digestion or with the appetite, aspirin in equal dosage may be substituted. Under this method of treatment in cases in which attacks had been occurring every month or six weeks the intervals have been increased to six months or a year, and in many cases the attacks have entirely ceased. Spasmodic treatment is of little value; only persistent treatment is effective, and there must be confidence and co-operation on the part of the family or any treatment will fail.

An important requirement in the management is that the patient live a normal child's life. There should be a suitable rest period after the midday meal. Three meals are to be given daily, and there must be one free bowel evacuation daily without the habitual use of enemata. A liberal green vegetable diet with stewed fruit will do much to accomplish this. (See Constipation, p. 274.)

*Treatment of the Acute Attack.*—All food should be withheld. Hot bicarbonate of soda water, 10 grains in 3 to 4 ounces of water, should be given every hour if possible. If it is vomited, 1 teaspoonful of the solution is to be given at a time. If this or plain water is ejected, the stomach must be allowed to rest. Medication other than the bicarbonate of soda should not be attempted. After twenty-four hours, with a continuation of the vomiting, a colon flushing (p. 857) with 16 ounces of warm water containing 2 drams of bicarbonate of soda may be employed. This should be repeated at six- to eight-hour intervals. It is astonishing to note how much of this solution will be taken up if the tube is introduced well into the colon. Repeatedly patients have been observed to retain 2 pints a day. The procedure supplies fluid, relieves thirst, and prevents prostration and loss in weight. At the same time the bicarbonate of soda furnishes the best antidote to the acid intoxication that exists. If the colonic medication is not well retained, it should be used but twice daily, so as not to establish an intolerance.

Discretion must be used in giving food. Some children will have a disgust for all foods, and others will be as hungry as they are thirsty. This, however, is unusual. Twice-baked bread and unsweetened zwieback have been retained when nothing else could be kept down. Further, when the vomiting ceases and the child is on the borderland of convalescence, some one of the dried bread-stuffs often answers better than does fluid.

In a general way, however, a diet of broth, gruel (particularly oatmeal), skimmed milk, and dried bread is best for the first few days following an attack.

If the case proves resistant and but little of the bicarbonate is retained, the procedure detailed under Treatment of Acidosis (p. 772) should be instituted.

*Transfusion:*

*Illustrative Case.*—In a case of severe acidosis seen with Dr. Mosher, of Brooklyn, a fatal outcome seemed imminent. Bicarbonate of soda freely administered and two infusions of bicarbonate of soda with 4 per cent. dextrose, given intravenously, failed to produce the slightest improvement. Transfusion of human blood was decided upon, and 6 ounces of citrated blood was given. The improvement following the use of human blood was most remarkable. The hyperpnea ceased, the pulse improved, and the entire expression of the child changed in a very few hours. He made a complete recovery, all traces of acidosis disappearing within five days after the transfusion.

### CYCLIC DIARRHEA

Excess of sugars and fat in the diet of children of the so-called lithemic type may produce characteristic gastro-enteric effects entirely independent of intestinal and stomach digestive conditions. Patients of this type represent those who possess a poor capacity for the metabolism of these substances.

Cases of this kind are not at all unusual, and are usually attributed to errors in diet, to fatigue, to overexcitement, or nervousness.

**Symptoms.**—There may be a prodromal period of a few days, with foul breath, coated tongue, languor, and loss of appetite. More often the onset is sudden and without warning. There is sudden high fever, headache, vomiting, diarrhea, muscle soreness, and, rarely, delirium. Abdominal pain may be present, colicky in character. The fever rarely lasts longer than two or three days—often not longer than one day. The gastro-intestinal manifestation of the toxemia may persist for a shorter or longer time. Some children will have one or two vomiting seizures; others none. The intestines, however, are much disturbed. Loose watery stools are frequent, and defecation is attended with considerable pain and tenesmus.

After an indefinite period of time—usually one to three days—the symptoms abruptly subside, and the child becomes hungry and begs for more food than is good for him. Usually after such an attack the child feels unusually well, and no evidence of the seizure remains.

In the course of a few weeks the identical process is repeated, although the mother volunteers the information that the child has been carefully fed and that the attacks cannot be attributed to indiscretion in diet.

Occasionally such cases are associated with cyclic vomiting.

*Illustrative Case.*—A boy six years of age almost always—such was the history—began the cyclic vomiting attack with the symptoms as described. Vomiting ordinarily did not begin until the fever and the urgent intestinal symptoms had subsided.

The attacks are quite apt to be followed by constipation. These gastro-intestinal crises become as distinctly periodic as those of cyclic vomiting and spasmodic bronchitis. A large number of these patients have been brought for treatment solely because of the periodic attacks

which are referred to by the mother or nurse as "indigestion," "gastritis," or "biliousness."

If the attacks are frequent, signs of malnutrition may be noted. Usually the patient has resistance of a low order and is apt to be nervous and pale. The muscles are flabby. The tongue may be habitually coated. The child is chronically tired, "or never quite well." This description obtains in the most severe cases. Children, however, who undergo the periodic attacks at intervals of several weeks suffer but temporary inconvenience. The acetone breath has been present during the attack in a few of the cases, although its occurrence has been the exception.

*Illustrative Cases.*—*Case 1.*—A girl, three years of age, of decidedly gouty antecedents in both parents, had, for the eighteen months previous to examination, attacks of "indigestion" every six weeks. There was no vomiting. The temperature rarely rose above 103° F. There was pronounced diarrhea with little mucus. At each attack she had been given castor oil and a reduced diet, and was well in four or five days. Between the attacks she was fairly well, except that the tongue was never clean and there was a persistent low-grade dermatitis on the neck and upper portion of the chest, which had resisted the treatment of different dermatologists. The child had been fed with reasonable care under medical direction. There had been no gain in weight during the year.

She was given a mixed diet of meat, poultry, fish, green vegetables, and cereals. One pint of skimmed milk or fat-free buttermilk was allowed daily. Sugar of every kind was prohibited. Raw fruit was not permitted. Ten grains of bicarbonate of soda was given daily for several weeks. During the twenty-one months of treatment there was no suggestion of the former trouble.

*Case 2.*—A boy six years of age had repeated attacks of diarrhea lasting from two to ten days. The majority of the attacks occurred during the warmer weather, but there were also three or four during the winter. There was fever, rarely higher than 102° F., and rarely vomiting. Dietetic restrictions of the intake of sugar and fat were carried out, and skimmed milk in small amount was allowed during the next three months—July, August, and September—a period during which he had never before been well. He now remained perfectly well, and during this time gained 1½ pounds in weight. There ensued no repetition of the attacks.

Many histories of cases might be cited in which the periodic intestinal crises were relieved by the withdrawal of fat and sugar from the diet, and by the free use of bicarbonate of soda for protracted periods. Starches appear to exert no unfavorable influence on the condition and, similarly, sugar that is manufactured by the organism exerts no unfavorable influence.

What appears to be dietetic idiosyncrasy and incapacity in not a few instances has been explained by defective gastro-intestinal mechanics, sometimes in association with faulty posture. Children with recurrent diarrhea should be given the benefit of a serial x-ray study of the gastro-intestinal tract.

**Treatment.**—As indicated, the treatment consists in withdrawing fat and sugar largely from the diet, and in the use of bicarbonate of soda. If constipation is present, 30 grains daily of the soda may be given with sufficient aromatic cascara to keep the bowels active. Stewed fruits and cereals are usually readily taken without sugar. If necessary, small amounts of saccharin may be used for sweetening. Eating between meals is forbidden, and the child is made to take an after-dinner rest of one and one-half hours. Stress of all kinds must be avoided.

## ACETONURIA IN CHILDREN

Ketone bodies occur in the urine in a wide variety of disorders, and are due to defective fat metabolism. They are present in diabetes, acidosis, inanition, and malignant diseases. They may be present in practically every other disease of childhood, particularly in the exanthemata.

The presence of acetone in the urine is not necessarily due to starvation or fever as we find it repeatedly when these conditions do not exist. We have found it repeatedly in children who were on a liberal carbohydrate diet.

*Illustrative Cases.*—In two typical cases the patients showed a persistent acetonuria when on ordinary foods. The odor of the acetone breath had been noticed by the mother in each case. When the fats were entirely eliminated from the diet the acetone disappeared.

A boy six years of age had repeated seizures of periodic fever, the temperature ranging from 103° to 105° F. for four or five days, without other signs than excessive acetone in the urine. There had been several of these attacks during the previous two years, one about every two or three months. Treatment during the second year had not been attempted because the child recovered just as well without treatment. "The fever had to run its course." With elimination of fat, eggs, and cane-sugar from the diet the attacks ceased and did not recur during the ensuing five years.

Children who readily develop acetonuria do not necessarily have attacks of true acidosis. Children, however, who are subject to attacks of true acidosis, will frequently have acetone in the urine with minor ailments with fever.

**Treatment.**—Fats must be given sparingly. Cane-sugar should be given in small quantities if at all. The usual diet contains sufficient carbohydrate to supply the needs of children, without cane-sugar. If sugar is given it is best to use honey or maple sugar.

## PERIODIC FEVER

Febrile cases somewhat resembling the above are not of unusual occurrence. The clinical condition is that of periodic fever without another symptom.

*Illustrative Cases.*—*Case 1.*—The temperature of one patient, aged four years, ranged from 102° to 103.5° F. and lasted four to six days. This child came for treatment because of the periodic elevation of temperature which could not be accounted for. During his third year there were six of these temperature periods. In the fourth year there were four, all during January, February, and March. There was no gastrointestinal association and no clinical evidence of disease to account for the temperature periods. The mother stated that "the breath smelled like chloroform" during the attacks. An exhaustive examination failed to detect anything wrong with the child other than a persistent erythema at the angle of the mouth on the right side. The patient was given a diet free from fat and sugar. Thirty grains of bicarbonate of soda were given daily. Two years elapsed without a return of the temperature period.

*Case 2.*—In the case of another boy, aged six years, the temperature period persisted two to five days, and the range was 100° to 104° F. During the attack the tongue was coated and the patient complained of being very tired. The attacks appeared without warning and disappeared without other evidences of illness than the fever. There was no objective gastro-intestinal disturbance. In one year there were five temperature periods; during the next year, three.

In neither of these cases was there another sign of trouble than the recurring temperature; the children had been treated and examined repeatedly with an aim to determine the cause.

In all, six examples of this fever phenomenon were observed. All the patients were relieved promptly by removing sugar and cow's milk fat from the diet, and by the interval use of bicarbonate of soda.

THE SUBOXIDATION SYNDROME<sup>1</sup>

Another group of children entirely apart from the foregoing are those who fall into our classification of the suboxidation syndrome.

Children coming under this heading are usually but by no means always found among the offspring of the well-to-do. The forebears of the children presenting this syndrome are usually those who have lived an indoor occupational existence for two or more generations, devoting their efforts to intellectual pursuits and not to manual labor.

*A child with the suboxidation syndrome is one whose metabolic functions are habitually below the normal.* He may be overweight or of average weight; usually he is underweight. Such children have a lowered capacity in endurance, because of physical weakness, although as a rule they are precocious and mentally overactive and possess much nervous energy. One of the striking features is the dryness of the skin with a tendency to erythema and mild eczema. Patchy areas of inflammation are particularly found about the mouth. Perspiration is scanty and the child rarely perspires except on very hot days. The hands and feet readily become cold in cold weather and low temperature is keenly felt. This symptom is often remarked by the parents. In fact, extra heavy outdoor garments are required during the winter months. In most cases a moderate anemia is present. The appetite is capricious and constipation is the rule. The body temperature is usually below normal in the early morning and often rises above normal under activities and stress.

One of the outstanding features of this syndrome is a marked tendency to afebrile rhinitis and bronchitis. The child is scarcely free from one attack when another supervenes. There is a chain of these respiratory affections throughout the winter. The colds are sufficiently severe and frequent in occurrence to interfere seriously with the activity of the patient, and much time is lost in school and outdoors.

As might be expected, it is rare to find a patient of this type who has not had the tonsils and adenoids removed, with little or no benefit.

As a class such children are rather immune to actual infection of the respiratory tract, although pneumonia and infectious bronchitis may, of course, occur. While they show a certain resistance to bacterial infections of the respiratory mucous membrane, these patients quite frequently are subjects of protein sensitization; and bronchitis, when it occurs, is likely to be of the spasmodic type.

Another feature of the syndrome is the tendency to attacks of recurrent vomiting, in which the vomiting may occur only once or repeatedly for a few hours or a day or two. These seizures may have occurred at fairly definite intervals for several months or years.

In some of these patients transient skin rashes or "eczema" may be the predominating manifestation.

In other cases because of anemia or malnutrition or lack of increase in height for a period of several months, the physician is consulted.

Other cases will afford the history of an elevation of the temperature, lasting one or more days, occurring at fairly regular intervals, without other manifestations than those of heavy breath and a coated tongue.

<sup>1</sup> Kerley and Berman, Amer. Jour. Med. Assoc., May 1, 1920, vol. 74, pp. 1226, 1227.

Not all cases show an identical train of acute manifestations. In one respect, however, these children are very similar: They have a defective metabolism for the soluble carbohydrates and for fats, particularly for cow's milk fat in the amount that we have accustomed ourselves during the last few decades to give to children.

*Illustrative Cases.*—*Case 1.*—A boy, aged three years, weighing 29 pounds and without physical abnormality, had been subject to recurrent attacks of elevation of the temperature since the age of one year. They occurred about every two months, being characterized by loss of appetite, coated tongue, and listlessness, with a temperature of from 101° to 103° F., the fever periods lasting from three to five days. There was rarely vomiting. The skin showed scattered areas of erythema. He was restricted to a diet free from cow's milk fat and sugar. During the next eight months there were no further attacks of illness, and he gained 3½ pounds in weight and 2½ inches in height.

*Case 2.*—A girl, aged six years, who weighed 47½ pounds and who was without physical abnormality, had habitually a coated tongue and poor appetite. Meal times were a trial to the other members of the family. In disposition she was irritable. Her complexion was sallow and the skin was dry over the back of the neck, where there was persistent erythema. There were patchy areas of dermatitis about the mouth, causing considerable disfigurement. She was subject to frequent catarrhal colds. One followed the other so rapidly that it was difficult to say when one was finished and another began. Tonsils and adenoids had been removed without benefit. It was with concern that the parents looked forward to the approaching winter.

She was given a diet from which sugar was largely excluded, enough being allowed to make the food palatable. Butter was forbidden. One pint of skimmed milk was allowed daily. Aside from these restrictions the food given was that of any well child of her age. After two months under this management she weighed 53 pounds (a gain of 6¼ pounds). There had not been a day's illness. The tongue was clean and there was no trace of eczema. She was happy and good natured.

During the final six months of observation there were only two slight colds, and the skin remained clear.

*Case 3.*—A girl, aged eight years, weighing 51½ pounds, gave the history of early eczema and difficult feeding, and "had always been on a diet for her skin." The immediate occasion for the consultation was the occurrence of vomiting attacks at intervals of from four to five weeks. The attacks usually lasted from one to two days, during which time the vomiting occurred frequently. The tongue was much coated at this time, and there was a moderate elevation of the temperature—from 100° to 102° F. After a seizure she was left very weak, and required several days for recuperation. The heart and lungs were normal. The blood showed 50 per cent. hemoglobin, and 4,700,000 red cells. The urine was entirely negative. She had been taking 1 quart of milk daily in addition to that used on cereals and in puddings. Sugar had been allowed with the customary freedom. She was put on the usual mixed feeding suitable for a child of her age, with restriction to skimmed milk and no sugar. After ten weeks and four days she weighed 56 pounds, a gain of 4½ pounds. The mother reported that during the interval there had been no vomiting and no fever; the tongue remained clean and the bowels regular. This case was followed for five months without a return of the vomiting seizures.

*Case 4.*—A boy, aged seven years, with a height of 47½ inches and a weight of 42 pounds, came for treatment January 2, 1920, because of "frequent colds, persistent wheezing in his chest, and a cough which was relieved only by warm weather." The condition had existed for three years, with a particularly severe cough since the preceding November. The patient was thin, pale, and weak. The appetite was poor. Food had to be forced. The blood showed 70 per cent. hemoglobin and 4,200,000 red cells. The urine was negative. The heart action was rapid, but the heart sounds were normal. Examination of the lungs revealed mucons and sibilant râles fairly evenly distributed with evidence of slight bronchial spasm. The tonsils and adenoids had been removed. There was no elevation of the temperature. Acting under medical orders the child had been generously supplied with sugar, cream, milk, and butter with the idea of improving his physical condition.

Our treatment was to order a general mixed diet largely sugar-free, 1 pint of milk daily, and very little butter. One pint of a Vichy water was to be drunk daily. The further instructions were that the boy should remain in bed until 10 a. m. each day, rest one and one-half hours after the midday meal, and retire at 7 p. m.

He was allowed to go outdoors. No cough mixtures were given.

There was a betterment of the cough in three days, with a gradual cessation complete in eighteen days. Fourteen days after the first examination the bronchitis had entirely disappeared. After six weeks under treatment the weight was 47 pounds,

a gain of 5 pounds, with a marked improvement in the general appearance of the patient, and an entire absence of cough. The appetite was most satisfactory, and foods such as vegetables and cereals, which the patient previously had to be coaxed and forced to eat, were taken eagerly. The child remained free from the cough during observation throughout ten weeks.

**Comment.**—A noteworthy feature in nearly every case treated has been the improvement in appetite and the marked gain in weight as soon as the fat and sugars which had been given above the capacity of the patient had been removed from the diet. Foods such as vegetables and cereals which have been taken with reluctance and in only small quantities are often taken eagerly.

An examination of the urine in a certain percentage of these cases shows a slight but constant acetonuria on an ordinary diet, even when the patients are apparently well. Those subject to attacks of vomiting show a marked acetonuria during the attack. A great majority exhibit a marked acetonuria with acute febrile illness.

A study by Dr. L. A. Berman of the blood of the patients we have come to classify by the designation "suboxidation syndrome" has shown, during the intervals of apparent health, a variable hyperglycemia varying from 130 mg. of glucose per 100 c.c. of blood to 280 mg. per 100 c.c., the average being 163. The series comprised 67 cases. Of these, 27 were cases of recurrent vomiting, sometimes alternating with bronchitis or eczema as the predominating symptom, and showed an average blood-sugar of 175 mg. per 100 c.c.; 3 came for recurrent pruritus, averaging 170 mg. per 100 c.c.; 11 exhibited eczema as the predominating symptom, averaging 148 mg. per 100 c.c.; 2 came for recurrent attacks of fever, with coated tongue and acetone breath, averaging 162 mg. per 100 c.c.; and 23 who had frequent colds and bronchitis as their chief complaint averaged 160 mg. per 100 c.c.

The blood-sugar of 92 children not belonging to this group was also examined. The sugar content was found to range between 80 and 125, averaging 105. These subjects included those who came for examination and feeding, for malnutrition, adenoids, intertrigo, enuresis, simple anemia, constipation, proteinogenous asthma, obesity, chronic nephritis, essential headache, chronic cervical adenitis, anorexia, acute bronchitis, ties, non-epileptic convulsions, recurrent vomiting with dilated stomach and redundant sigmoid, recurrent vomiting unrelated to mechanical defects, frequent colds, asthma due to enlarged tonsils and adenoids relieved by operation, migraine, urticaria, mucous colitis, flat-foot, chorea, seborrheic dermatitis of the scalp, cardiac disease, tetany, pylorospasm, gonococcus vaginitis, epilepsy, habit spasm, chronic otitis media, and enlarged tonsils.

Four cases belonging to the suboxidation syndrome group were characterized by attacks of vomiting at the height of the attack. They showed a hypoglycemia, the figures being 80, 85, 85 and 70 mg. per 100 c.c. One case of bronchitis with bronchospasm examined in the attack had 75 mg. sugar per 100 c.c. of blood.

Ten cases classifiable clinically as belonging to the suboxidation syndrome group did not show any definite hyperglycemia at the time of examination. Of these there were 4 cases of frequent colds, with an

average blood-sugar of 105 mg. per 100 c.c.; 2 cases of "eczema" averaging 97; 3 cases characterized by recurrent vomiting averaging 106, and one of recurrent diarrhea showing 105.

The method used to determine the blood-sugar was an adaptation of Benedict's<sup>1</sup> modified picric and picrate method to finger blood along the lines followed by Epstein in applying the original picric acid method:

Of the blood, 0.2 c.c. was obtained from a finger and was immediately mixed with 0.8 c.c. of distilled water, the blood laking after a little shaking. To this, 1.5 c.c. of Benedict's picric acid picrate reagent was added drop by drop and thoroughly mixed. The precipitated proteins were then thrown down by centrifuging. Of the supernatant fluid, 1 c.c. was taken, 0.5 c.c. of 20 per cent. anhydrous sodium carbonate added, and the mixture, corked with absorbent cotton, was placed in a water-bath for ten minutes. This was compared in the Kuttner colorimeter with a standard solution of potassium dichromate, made up by matching against a solution of glucose containing 0.2 mg. to the cubic centimeter, treated as the blood was treated, described above.

### DIABETES INSIPIDUS

Persistent polyuria—diabetes insipidus—is rare in children. The disease is characterized by extreme thirst and the passage of large quantities of pale urine, the condition continuing for months and years.

Temporary or transient polyuria is of occasional occurrence. There is unusual thirst and the passage of abnormally large amounts of urine, a condition continuing for a few days or a week or two.

**Etiology.**—The cause of persistent polyuria is but little understood. Cases are on record in which the condition has seemed to be closely associated with brain tumors, hydrocephalus, and trauma. But 3 cases have come under our observation. In these 3 no cause could be discovered. Temporary or transient polyuria has been personally observed only in nervous girls of hysteric tendencies. It is most apt to develop near the close of the school year, when the child is considerably reduced or somewhat excited in anticipation of undergoing examinations. The disease is probably of congenital origin.

**Symptoms.**—Both the mild and severe cases are characterized by thirst and the passage of large amounts of urine, ranging from 50 to 100 ounces daily. The specific gravity is low—1002 to 1010. The amount of urea and uric acid excreted varies but little from the normal. A diet low in salt and protein reduces the urinary volume.

Due to the rapid excretion of fluid the skin is dry and the hair and nails may show trophic disturbances.

In 2 of the cases of true diabetes insipidus there was a secondary anemia and a moderate degree of malnutrition. One patient was much undersized, and at the age of five and one-half years weighed 30¼ pounds and was 37½ inches high. That the lack of development was due to the polyuria, however, is extremely doubtful.

**Diagnosis.**—Polyuria is to be differentiated from diabetes mellitus by examination of the urine. The absence of sugar determines the diagnosis. Of further significance is the characteristic increase in the amount of urine excreted in diabetes insipidus when the ingestion of sodium chlorid and protein is increased.

<sup>1</sup> Benedict, S. R., A Modification of the Lewis-Benedict Method for the Determination of Sugar in Blood, *Jour. Biol. Chem.*, 34, 203, April, 1918.

**Treatment.**—In the cases of functional nervous origin the cure takes place by a change of environment. When the nervous stress is removed, the symptoms subside.

In the true cases no means of treatment have been of avail in our hands.

In the case of the boy referred to various methods of management were attempted, without success. With a diminution of the fluids taken there was a corresponding reduction in the output. As soon as the patient was allowed freedom in drinking the frequency in urination and the polyuria returned.

Drugs have been of no value with the possible exception of pituitary extract, which is said to have a specific action in this condition.

### DIABETES MELLITUS

True diabetes in children is, fortunately, a comparatively rare disease.

**Etiology.**—Much concerning the ultimate causation of diabetes mellitus is not known. Heredity is supposed to play an important part, but this association in our experience has been infrequent. In 11 cases in children under nine years of age no etiologic factor could be discovered. Our youngest patient was nine months of age at death. The disease in this instance was known to have existed but three weeks. Among adults, Hebrews are more liable to the disease than others. Jewish children, however, have shown no special susceptibility.

Previous severe infection is now looked upon as an important etiologic factor.

**Pathogenesis and Morbid Anatomy.**—In "A Study of the Pathological Anatomy of the Pancreas in 90 cases of Diabetes Mellitus" published in 1909, R. L. Cecil reviewed the work of Opie, von Mering, Minikowski, Sauerbeck, and others, and reported that anatomic lesions of the pancreas occur in more than seven-eighths of all cases. In the cases associated with lesions of this organ the islands of Langerhans were constantly involved in changes ranging from sclerosis and hyaline degeneration to infiltration with leukocytes and hypertrophy, while in some cases these islands were the only portions of the gland involved. In 12 per cent. of the cases investigated no pathologic changes were found, although in half of the 12 per cent. the gland was smaller, or the number of islands less than normal. Three-fourths of the cases presenting no lesions occurred in patients under the age of thirty.

Abt and Strouse reported 2 cases of traumatic diabetes in children. In one the diabetic symptoms followed a fall on the head. In the other the injuries were associated with only a brief period of unconsciousness, and the chief lesion was a compound fracture of the tibia. Both patients developed persistent glycosuria and other diabetic symptoms, and responded typically to treatment. Other cases might be cited of injuries varying from simple concussion to fracture of the skull, with a subsequent glycosuria or even permanent diabetes. Langstein recorded persistent glycosuria in 2 young infants affected respectively by hydrocephalus and malformation of the brain.

The subject of experimental diabetes was investigated by MacLeod. He stated that dextrose may appear in the urine as a result of deficient

utilization of this carbohydrate by the tissues, because of deficient renal function permitting the escape of sugar normally present in the blood,<sup>1</sup> or because of an increased production of dextrose in the liver. To the last of these sources of a hyperglycemia he attached the greatest importance. The hepatic conversion of the glycogen into dextrose was shown to be influenced by a reflex mechanism operating through the fourth ventricle and the splanchnic nerves. That certain drugs and the carbon dioxid present in the blood in asphyxia may produce hyperglycemia by their effects on these nerve centers controlling glycogen conversion was considered probable.

The influence of an internal secretion from the pancreas, while long regarded as probably important, is only now beginning to be fully understood. (See p. 786.)

The *urine* is ordinarily increased in amount, clear, acid, and of high specific gravity—1025 to 1050. The amount of glucose present varies widely, depending on the character of the diet, time of day, and time of meals. During certain periods the sugar may be absent. Acetone, diacetic acid, and beta-oxybutyric acid may be found, depending on the severity of the disease. The first two of these substances are oxidation products of the third, which appears only in severe cases.

*The Blood.*—The normal blood-sugar in children closely approximates the adult normal (80–110 mg. per 100 c.c. blood), except possibly in breast-fed newborn infants, when the blood-sugar is probably slightly lower.<sup>2</sup> In diabetes mellitus, however, the sugar may constitute 0.5 per cent. of the blood or even more. This varies with the diet, the time of day, and the ability of the patient to metabolize carbohydrates. There may be a moderate hyperglycemia without glycosuria, providing the sugar threshold has not been passed.

In severe cases with marked emaciation, in addition to the clinical signs of ketosis, impending coma, and the presence of the products of intermediary fat metabolism in the urine, there may be and usually is a marked decrease in the carbon dioxid combining power of the blood.

“This then is the worst picture of perverted metabolism in diabetes. Sugar cannot burn, fat burns only as far as beta-oxybutyric acid, and as for protein, a part of its amino-acids are converted into sugar and another part into beta-oxybutyric acid, neither of which can be burned.”<sup>3</sup>

**Symptoms.**—Diabetes mellitus is very constant in its symptomatology in children. An early and never-failing sign is loss of weight without apparent cause. The loss of weight is so pronounced that it is often the first symptom to which the attention is called. Thirst is also an early symptom. It is of a very urgent nature. The child never seems to be satisfied. The thirst is so great that the patient is awakened by it in the night and demands water. Milk or any fluids will be taken, but if a choice is given, water will be selected. Repeatedly patients have been known, if allowed, to drink 5 or 6 pints of water a day.

Frequent urination is always present, large amounts being voided; 100 ounces in twenty-four hours is not uncommonly excreted by a young

<sup>1</sup> Under normal conditions the blood contains about 0.1 to 0.15 per cent. of glucose.

<sup>2</sup> Lucas, W. P., et al., *Amer. Jour. Dis. Child.*, December, 1921, vol. 22, No. 6.

<sup>3</sup> Lusk, Graham, *The Elements of the Science of Nutrition*, 3d ed., 1917.

child. Enuresis occurs in over half the cases. The skin is dry; perspiration rarely occurs even on the hottest days or when the body is covered with warm clothing. A light brawny desquamation is not infrequently seen.

The child becomes listless. There is disinclination to play, and the interest in childish things flags.

The appetite is usually voracious, the child being not at all particular as to the kind of food taken. No matter how carefully the food is selected and prepared, the emaciation continues.

As the case makes its inevitable progress toward dissolution the emaciation progresses and the weakness increases until the patient is confined to bed. If an intercurrent disease, such as bronchopneumonia, does not terminate the illness, the untreated child dies from exhaustion or acetonemia.

**Diagnosis.**—The presence of diabetes is suggested by loss in weight and strength, in association with a voracious appetite and inordinate thirst and dryness of the skin. An examination of the urine and blood determines the diagnosis. The disease may be confused with persistent polyuria and with chronic interstitial nephritis. Here again the differentiation is made by the urine examination. Diabetic coma may be confused with meningitis, uremia, and other states of coma if urine examination is neglected.

**Duration of the Disease.**—Few child patients without insulin live longer than a year. The majority of cases in the past have terminated fatally in from three to six months.

**Prognosis.**—All our child patients, except those treated with insulin, have died within less than a year after the diagnosis was made. True diabetes is a fatal disease in both childhood and youth.

**Treatment.**—None of our patients treated by limiting the amount of fluid taken, by restricting the diet, and by using the opium derivatives and arsenic to the point of physiologic effect received the slightest lasting benefit. Bicarbonate of soda, furthermore, was given in large dosage. The sugar output was reduced, but the patients showed not even temporary improvement in general condition.

**Insulin.**—The introduction of insulin by Banting and Best, working in MacLeod's laboratory at Toronto University, has marked a tremendous advance in the treatment of diabetes. It had been pretty well established that the islands of Langerhans in the pancreas elaborate an internal secretion which is essential in controlling carbohydrate metabolism, the secretion of the acinar portion having no effect on this function. Attempts at preparing extracts of whole pancreas had failed because of the action of the acinar digestive ferments on the islet tissue. Ligation of the pancreatic ducts, however, caused degeneration of the acinar portion of the gland, permitting the extraction of the island tissue. This extract was found to lower the blood-sugar markedly in both normal and depancreatized animals.

Clinical experience has shown the efficacy of this extract in treating diabetics, especially the severe cases which occur in children. Careful dietetic measures must be maintained, but insulin raises the patient's food tolerance temporarily. The patient's caloric needs must be estimated, his

protein requirements fulfilled, a limited amount of fat provided, and sufficient carbohydrate added to make up the rest of the calories and insure complete combustion of the fat. Then sufficient insulin should be injected hypodermically to keep the blood-sugar close to normal limits. Rather than render the urine sugar free, it is better to bring the blood-sugar close to normal and permit a slight glycosuria. This acts more or less as a buffer against the occurrence of a hypoglycemia which is a very real danger. Clinically an overdose of insulin causing hypoglycemia manifests itself by marked hunger, weakness, vasomotor instability, accelerated pulse, sweating, vertigo, delirium, convulsions, low temperature, low blood-pressure, and death. The rapid administration of glucose by mouth or intravenously, as the case may require, will raise the blood-sugar and cause the symptoms to subside.

Whether the continued use of insulin permanently increases carbohydrate tolerance remains to be seen. At present the dose must be given hypodermically from one to four times daily, depending upon the severity of the case, in order to maintain the increased food tolerance which this extract provides. In each case the balance between diet and the amount of insulin must be carefully studied.

*Diet.*—The following are the ordinarily permissible articles of diet for a child ill with diabetes: Soup and broths made from meat, fresh and salt fish, shell-fish, occasionally egg, fowl, and game, smoked meats, sweetbread, cheese, spinach, celery, lettuce, cucumbers, cranberries, radishes, stringbeans, asparagus, squash, cabbage, egg-plant, tomatoes, onions, turnips, mushrooms, gelatin jellies sweetened with saccharin, butter, cream, olive oil, cod-liver oil, lemon, grape-fruit, sour apples, blackberries, raspberries, watermelon. Nuts of all kinds may be eaten. Only bread and biscuits made from gluten flour should be used. It is impossible to procure a starch-free gluten flour; the flour, however, should not contain more than 20 per cent. of starch.

## PELLAGRA

Pellagra is a systemic disease with a course typically marked by intermissions, affecting chiefly the skin, gastro-intestinal tract, and nervous system. This disease has undoubtedly been endemic in Southern Europe for centuries and has long been known under such names as "Alpine Scurvy," "Corn-bread Disease," and "Italian Leprosy." In the past two decades it has assumed special prominence in the Southern United States. The first recorded descriptions are those of Cazal and of Frapoli, made about the middle of the eighteenth century. Today it is estimated that there are 100,000 cases in Italy and at least 25,000 in the United States.

*Etiology.*—Pellagra has been generally regarded as a metabolic disease of food origin rather than an infectious disease. Dermatitis of the characteristic type has been produced experimentally by Goldberg, in individuals who were fed on a diet rich in maize and rice to the exclusion of animal and legume proteins, but whether the condition is due to deficiency of vitamins in maize, toxins derived from maize, posions germinated in diseased corn, or should be viewed as an example of anaphylaxis affecting particularly tissues sensitized by exposure to the sun has

not been elucidated. One of the most interesting theories as to the origin of pellagra is that of Alessandrini and Scala, who stated positively that it is a form of chronic acid intoxication caused by colloidal silica in drinking-water and that the disease is localized and contracted only in those regions where the water-supply is derived from clay soils. The explanation of the production of the disease is thus purely biochemic: The silica in colloidal solution attaches to protein substances, and in this manner it fixes salts in the tissue cells of the body with the liberation of water and an acid—most frequently hydrochloric acid. The abstraction of the water and the diminution in alkalinity of the tissue fluids thus induced are productive of the drying of the tissues and the acid intoxication which are so characteristic.

Objections to the vitamin deficiency theory and to the colloidal silica theory have been met more or less convincingly by the respective advocates of each belief, but the predominant view today is that pellagra is a vitamin-deficiency disease, or a low-grade infection of intestinal origin.

Spring and fall are the seasons of greatest incidence of pellagra and, similarly, these are the times for recurrences of the disease in aggravated form, once it has gained a foothold in a given subject. Most of the patients are between the ages of twenty and forty years and only about 9 per cent. are under the age of fifteen years. Cases observed in infants have never been proved in any degree hereditary.

**Pathology.**—The skin lesions exemplify changes varying from an early erythema-like sunburn to thickening, pigmentation, and atrophy. Except for atrophic changes in the gastro-intestinal tract and fatty degeneration of the viscera, the most pronounced additional effects of the disease are confined to the spinal cord and brain. There is an endothelial proliferation in the capillaries of the pia with some connective tissue increase, together with diminution in the nerve-cells of the cortex and a considerable degree of gliosis. In the cervical cord the posterior columns show degeneration, and in the dorsal region the lateral columns are similarly affected.

**Symptomatology.**—Following a prolonged "incubation" period marked by malaise the average pellagrin gives evidence first of digestive disorder. This is indicated by redness and coating of the tongue frequently combined with actual stomatitis, flatulence and abdominal cramps, and diarrhea. At some period the last-named symptom occurs in fully 85 per cent. of cases. Almost as soon, if not equally early, the skin on the exposed parts of the body becomes the seat of an erythema which develops into actual dermatitis. After a few weeks this inflammation subsides, leaving the integument bronzed and indurated over a period of possibly many months. Mental derangement is common, but this symptom in children calls for only passing mention. Vertigo and headache are not infrequent and many patients show a positive Romberg test, and upon ocular examination, changes in the retina and anomalies in the fundus reflex. The lower tendon reflexes are usually exaggerated, but are at times diminished. The disease ordinarily runs a subacute or chronic course with a tendency to subsidence during summer and winter, with recurrences, as has been noted, during spring and fall. At these periods renewed severity in the cutaneous and gastro-intestinal symptoms is the

rule. Rises of temperature are not common. Malnutrition and anemia are invariably present, but the changes in the blood are in no way pathognomonic. As a rule there is with the anemia a slight leukocytosis and a moderate mononucleosis of from 10 to 20 per cent. The urine contains an excess of indican.

**Prognosis.**—In children pellagra is ordinarily less severe than in adults. The adult mortality in the white race has been estimated at 27 per cent. Complicating diseases including principally tuberculosis, malaria, and hookworm disease doubtless contribute to this high mortality. Notwithstanding the tendency of pellagra to run a chronic course over months and years, occasional acute cases are observed which prove fatal in as short a time as a fortnight.

**Diagnosis.**—Pellagra may at times be confounded with eczema, scurvy, dysentery, tuberculosis, and leprosy. The character and distribution of the cutaneous lesions, the significant digestive disturbances, the peculiar course of the disease, and the history of other cases in the locality where the patient has resided are the points of greatest value in reaching conclusions in a given case.

**Treatment.**—Preventive measures under Health Department supervision are essential in all communities where pellagra is endemic. Rules to govern the care and sale of corn in such communities are justifiable, even though spoiled maize shall be proved to have no part in the causation of the disease. In view of the findings of Alessandrini and Scala, drinking-water should be provided which is free from excessive quantities of colloidal silica. All cases of the disease should be reported and given opportunity at least to have the advantage of institutional care. Goldberger recommended a diet rich in legumes and animal proteins, comprising milk, eggs, and meat. Baths, salt rubs, and massage are of special value in the management of cases in children. Most authorities administer arsenic up to the physiologic limit, with intermissions of a few days at stated periods. Fowler's solution, atoxyl, and sodium cacodylate are the preparations of choice. The last of these has been administered intramuscularly with good results by Deaderick and Thompson in dosage of 3 grains daily for an adult. Quinin hydrobromate has received particular advocacy from Dyer. Serotherapy, consisting in injections of serum from cured patients in healthy individuals, horse-serum specially prepared according to the method of Nicolaier, or serum from the patient himself (auto-serotherapy) has given favorable results in a number of instances.

Alessandrini and Scala believed the specific treatment is the administration of alkali to combat the acid intoxication produced by silica. The preparation of choice is sodium citrate, and this they administered hypodermically in a 10 per cent. solution. Oral administration was also found by them to be effective. Sodium bicarbonate may also be given freely.

With any form of specific therapy symptomatic treatment must be employed and this demands the use of local applications for the skin lesions, intestinal astringents and antiseptics, and mouth-washes, preferably containing chlorate of potash. Concurrent diseases, such as hookworm disease and malaria, should not be neglected.

## BERIBERI

Beriberi is a disease the leading characteristics of which are multiple neuritis and general edema. The disease occurs in individuals whose food is deficient in a certain vitamin.

**Etiology.**—Beriberi is most common among rice-eating Oriental peoples, but is endemic also in Brazil. The prevailing view held for a considerable time was that the specific cause was a micro-organism which elaborates a toxin productive of neuritis. This view has now given place to the theory of food deficiency. Thus in the last two decades it has been established that the disease is prevalent only among peoples subsisting largely on a diet of rice which is "polished" or highly milled. The removal of the husk of the rice with the subjacent layer containing protein and fat leaves little but the starch, and such rice has been shown to be deficient in antineuritic vitamin and phosphorus. The phosphorus pentoxid content is more or less directly proportionate to the amount of vitamin present and rice containing less than 0.4 per cent. of  $P_2O_5$  will cause beriberi, whereas rice containing more than 0.4 per cent. will prevent beriberi.<sup>1</sup> Lack of vitamin in other starch food may similarly be responsible for the disease in people who do not eat rice, but subsist on a similar unbalanced ration. Overheating of food destroys the vitamin.

**Symptoms.**—The leading manifestations are multiple neuritis and edema. When paralysis predominates the term *dry* or *atrophic beriberi* is applied to the disease; if the edema is pronounced, the term *wet beriberi* is employed. Fever is seldom noted. Progressive asthenia, weakness in the legs, cardiac palpitation, and shortness of breath constitute the early manifestations. With the progress of the affection symptoms of multiple neuritis become apparent, such as localized sensory and motor disturbances. Coincidentally localized edema develops in the extremities. Edema in the serous cavities of the body may follow. Nausea, vomiting, and epigastric discomfort are common. Eventually foot-drop, wrist-drop, and atrophy of the muscles affected by the neuritis develop. Blood examination reveals only the existence of a simple anemia. The urine may contain albumin, but seldom shows the presence of elements indicative of nephritis. Special forms of beriberi are the *rudimentary type*, the *fulminating* or *pernicious form*, and *infantile beriberi*. The last type develops in infants of mothers who have the disease and is characterized by vomiting, edema, and symptoms of cardiac failure.

**Diagnosis.**—Sporadic cases may be difficult of diagnosis. In children beriberi may be confused with nephritis, alcoholic neuritis, and the neuritis of diphtheria. The habits of life of the patient, the distribution of the paralysis, and the urinary signs aid principally in confirming a doubtful diagnosis. Leprosy accompanied by neuritic manifestations is at times mistaken for beriberi.

**Prognosis.**—The death-rate varies markedly in different epidemics, ranging from 2 per cent. among Japanese soliders who were treated in military hospitals to as high as 50 or 60 per cent. among untreated and ignorant peoples. In individual cases the prognosis should be guarded

<sup>1</sup> Barker, Monographic Medicine, vol. iv, p. 777.

as in cases of post diphtheric paralysis because of the constant danger of sudden cardiac failure.

**Treatment.**—Prophylaxis is most important. A well-balanced diet is sufficient to prevent the disease in an individual who will observe the ordinary laws of hygiene. Nursing mothers who have the disease should promptly be made to cease nursing. Treatment of the developed disease is largely symptomatic. The diet should be light but nutritious, and contain the elements lacking in polished rice. Brewer's yeast, powdered rice husks and adzuki, and mango beans are among the articles recommended as favorable to a cure. Rice itself should be removed from the diet. Saline laxatives are of great value and the use of these should be supplemented with the administration of diuretics, such as potassium citrate or even diuretin. Cardiac stimulants which do not upset the stomach are of value at times, but the routine use of digitalis has few advocates. For the vomiting small doses of morphin are permissible if bromid proves ineffectual. As soon as edema disappears affected extremities should be treated by passive movements, massage, and electricity. Complete change of climate and environment does most to promote convalescence.

#### ACRODYNIA

For a careful sifting of the literature relating to this disease we are indebted to William Weston, who gives to J. B. Bilderback the credit of being the first to recognize and describe this disease in the United States. Weston claims to have found authentic account of its existence in Europe as late as the sixteenth century. A recent contribution by this author<sup>1</sup> aroused a great deal of interest in the disease, and a considerable number of additional contributions from different sections of this country have appeared. That this condition constitutes an entity appears to be established and that it will eventually be classed among the deficiency diseases is probable.

**Symptoms.**—In a personal communication Weston has described the symptomatology as follows:

"The onset of the disease may be either abrupt or so gradual that its true nature may not become manifest for several weeks. Usually the first symptoms to attract attention are: the child becomes peevish and fretful, loses his appetite, and sleeps poorly. Soon the feet and hands become red and swollen accompanied by intense itching or burning of the palms and soles. A rash may also appear on the tips of the nose, the ears, and cheeks or it may cover the entire body except the back of the neck. Soon after the rash appears desquamation begins. The desquamation sometimes involves all the layers of the skin and deep necrotic ulcers form. Usually, however, the desquamation only involves the superficial layers, leaving a bluish-red, glistening surface, feeling cold and clammy to the touch. These areas may be either hyperesthetic or anesthetic. Coincident with the symptoms just enumerated occur profuse irritating sweats that add to the child's discomfort. It becomes pale and emaciated. The eyes become irritated and very sensitive to light. The hair becomes dry and thin and areas of alopecia appear. The muscles become flabby

<sup>1</sup>Arch. of Ped., September, 1920.

and if the child has walked it can no longer do so. It lies with its face buried in the pillow or against its mother's shoulder, its hands in constant motion, its feet rubbing against each other, and constantly moaning or begging that its feet be rubbed. Such a picture of abject misery once seen can never be forgotten.

*"Skin.*—The skin manifestations are uniformly present and invariably involve the palms and dorsal surface of the hands and soles, less often the dorsal surface of the feet. They are cold, clammy, and cyanotic. There occurs an erythematous rash most marked at the tips of the fingers and gradually diminishing until at the wrists or forearms it entirely disappears. There is no line of demarcation as in pellagra.

"Less often there occurs a rash on the tip of the nose, the ears, and cheeks. Occasionally the entire body except the neck is covered with an erythematous rash. The rash may be constant or it may disappear and recur. When it disappears pigmented spots appear. As the rash fades there will occur a desquamation which may involve only the superficial layers of the skin or may involve all layers. The surface is bathed in a profuse, irritating sweat. The extremities are invariably edematous, but there is no pitting upon pressure. Less often this edema may be observed about the face or other parts of the body. The rash usually appears as an erythema, but may appear as macules, papules, or pustules, and in a given case all these may be observed.

"The trophic changes in the skin may at times be very severe and result in gangrene of the fingers or deep ulcers on the toes or soles.

*"Hair.*—The hair is dry and tends to fall out. It not infrequently happens that the child pulls out 'handfuls' of hair. In other cases it will pull out hair by hair, leaving bald spots.

*"Eyes.*—Photophobia with conjunctivitis and lacerimation are the rule. Sometimes injections of the cornea and keratitis are present.

*"Teeth.*—Loss of teeth with or without pathologic changes in the gums is a manifestation often observed.

*"Nails.*—Change in the color of the nails is of frequent occurrence. Shedding of the finger and toe nails occurs in many cases.

*"Genito-urinary.*—Pyelitis accompanied by frequent and painful micturition and irregular fever is met with in many cases. Both albumin and acetone are found occasionally.

*"Gastro-intestinal.*—Loss of appetite is common. Anorexia is often present. Diarrhea and vomiting are met with in a small proportion of cases.

*"Nervous System.*—Irritability, restlessness, insomnia, and trichotillomania occur in nearly all cases. Paresthesia of the fingers, hands, toes and feet, especially the palms and soles is invariably present. Convulsions occur in a few cases.

*"Glandular.*—Cervical glands are often enlarged.

*"Reflexes.*—The reflexes may be unaltered, increased, diminished, or abolished.

*"Muscular.*—There occurs a distinct loss of tone in all the muscles. They become flabby and atrophy. Sometimes marked contraction takes place.

*"Respiratory.*—A nasopharyngitis is usually present. This occasionally

develops into a bronchitis or a bronchopneumonia. Very occasionally a pulmonary edema occurs.

*"Circulatory and Blood.*—The heart rarely shows any change. A secondary anemia is present in a fairly large proportion of cases.

*"Temperature.*—A slight rise in temperature often occurs. High temperature is seldom met with unless due to some complication.

*"Laboratory Findings.*—There usually exists a fairly regular relative polymorphonucleosis and an increase in the total number of leukocytes.

"The red cell count is not materially altered. The Wassermann is uniformly negative.

"Spinal fluid negative.

"Tuberculin skin tests and Schick tests negative.

"Blood-cultures uniformly negative.

"Feces negative for parasites.

"In cases studied from a metabolic standpoint it was observed that there was a lowered or negative nitrogen balance in some and in others a negative balance of bases. The excessive loss of nitrogen and bases occurred through the urine."

**Diagnosis.**—The disease most commonly mistaken for acrodynia is pellagra.

This error is not likely to be made if one recalls the following points: Acrodynia occurs at any season; pellagra usually commences in the spring or fall. Acrodynia shows no tendency to recur, produces a less persistent rash than pellagra, typically involves the body in an erythematous rash, seldom affecting the dorsal surface of the feet and ankles, seldom produces a severe diarrhea, does not occasion insanity but produces most acute wretchedness associated with the marked itching and burning not present in pellagra. Finally, acrodynia ultimately terminates in recovery, whereas in pellagra there is a comparatively high mortality.

**Prognosis.**—Spontaneous recovery is the rule. In fatal cases death has been due to complications.

**Treatment.**—The management consists in attention to the various symptoms as they appear. None of those observers who have described cases appear to have any definite line of treatment. This disease seems to be intractable.

Weston feels that lack of Vitamin B may be an important factor in the *etiology*.

## XXI. DISEASES OF MUSCLES, BONES, AND JOINTS

### DIAGNOSIS IN BONE AND JOINT DISEASES

It is not within the province of this book to enter the domain of orthopedic surgery. The practitioner, however, is the first to see cases of illness regardless of their nature, and bone and joint diseases are no exception to the rule. For this reason these diseases will be considered largely from the standpoint of diagnosis. In the examination for bone and joint diseases in runabout and older children the patient should invariably be stripped. He should then be encouraged to move about, to run and play, to sit down, to lie down, to roll over on his stomach and back again. He may be asked to pick up toys, to walk up and down stairs, to climb into a chair. By these means limitation of motion, a most valuable symptom in joint disease, is made apparent.

**Acute Peri-arthritis.**—In infants and young children observed in hospital work an infection of the peri-articular structures is not at all uncommon. The symptoms presented are those of superficial swelling, and at times redness and pain upon manipulation. Fluctuation will be present if the case is at all advanced. The shoulder- and elbow-joints in our cases have been the more frequently involved. The disease may be due to any of the pathogenic organisms. In one case an examination of the pus showed pure influenza bacillus infection. The gonococcus may produce either a peri-arthritis or an arthritis. Elevation of temperature is an inconstant symptom.

**Arthritis.**—In arthritis the symptoms are usually more urgent. The temperature usually is higher, 102° to 104° F., and there is complete loss of power in the limb involved, associated with pain, swelling, and redness. As in peri-arthritis, any one of the pyogenic organisms may be the infecting agent. Arthritis of one or more of the larger joints is not infrequent following sinus thrombosis with septicemia. In such cases the *Streptococcus hemolyticus* has often been the infecting organism, and its portal of entry to the body, the middle ear.

**Gonorrheal Arthritis.**—In gonorrheal arthritis the lesion is apt to be multiple. As many as five joints have been observed to be involved in one patient. The small joints of the hands are particularly apt to be involved in infants with gonorrheal arthritis. Arthritis and peri-arthritis are often confused with rheumatism. In the non-gonorrheal cases the urgency of the constitutional symptoms and the severe local lesion, with the rapid development of pus, render a diagnosis fairly simple. In gonorrheal arthritis one may have to look to the age as a point in differentiation. Children under eighteen months rarely have rheumatism, and in the very young, successive, severe, inflammatory joint infections should always arouse the suspicion of an infectious arthritis.

**Joint Tuberculosis.**—While tuberculosis may develop in any bony structure, that form with which we are particularly concerned in diagnosis affects the hip and spine.

*Tuberculosis of the spine* may occur in quite young infants. Our youngest patient was nine months of age. While the symptoms vary somewhat, depending upon the location of the inflammation, one symptom is almost always present early in the illness—stiffness, a tendency to hold the body rigid. The child moves awkwardly. If the cervical vertebra are involved, the head will be held fixed on the shoulders, often with a bearing slightly either to the right or the left, resembling the attitude of torticollis. If the dorsal or lumbar vertebra are involved, the child holds the body erect and all movements are made with care and caution. The shoulders are thrown backward, the child assuming a military attitude. Bending the body is difficult. When the child attempts to pick an object from the floor, the spine is held rigid, while extreme flexion takes place in the knees in order to bring the hand to the floor. In every motion the child attempts to protect the sensitive spine, making all voluntary motions with precision and apparent forethought. Pain referred anteriorly may be present, not always early in the case.

Early in the disease there is no deformity. The first objective sign to appear is a projection or undue prominence of one or more of the spinal processes. After the development of the angular bony deformity the disease is unmistakable.

*Tuberculous Disease of the Hip.*—This is very rare in infancy. The first symptom is a slight limp, due to spasticity of the hip muscles, which causes the child to step short. The onset of the disease is very gradual, and the limping may disappear for weeks at a time and return again, and again disappear. Pain is an inconstant early symptom, but may be indicated by night cries. Pain in the anterior portion of the thigh just above the knee may occur early.

*Illustrative Case.*—A boy twelve years old had a periodic limp or short step for six years; he had been treated for various conditions, particularly for rheumatism. An orthopedist, after several weeks of observation assisted by an x-ray, pronounced the condition tuberculous.

A shortening of the gluteal fold and a general flattening of the hip with an increased prominence of the trochanter are characteristic of hip disease.

The tendency to spasticity of the hip muscles furnishes a most valuable diagnostic aid. There is a general limitation of motion as compared with that of the sound side: abduction, adduction, flexion, extension, and rotation are all retarded. The joint appears fixed. Tilting of the pelvis, due to the muscular spasticity, consists in an elevation of the patient's back from the table when the extended leg of the affected side rests fully upon the table. In more advanced cases there is the eversion of the foot.

Outward rotation of the entire limb and apparent lengthening, pain, inability to walk, and abscess are the outcome in cases unsuccessfully treated.

*Knee-joint Tuberculosis.*—This form of tuberculous joint disease follows in order of frequency the two just discussed. The condition develops gradually, perhaps following an injury, and soon gives rise to

slight flexion and rigidity of the knee with an early morning limp which may wear off during the day. Eventually the child maintains the knee in fixed flexion, walking on the toes. The joint gradually develops swelling as the case progresses, and this enlargement is typically spindle shaped, covered with tense, shiny skin. To this appearance the term "white swelling" is applied. The x-ray is invaluable in showing the underlying joint condition. Atrophy of the muscles of the thigh and calf accentuate the swelling.

The prognosis in this condition depends upon its early recognition and effective treatment both locally and constitutionally. The tendency to ascribe the existence of a lame knee in a child to insignificant trauma or "growing pains" is indirectly productive of the crippling of many, who might otherwise have timely help.

*Dactylitis*.—This condition has been considered on pp. 768-770.

"Quiet hip disease" (*Legg's disease; Perthes' disease*) is an affection easily diagnosed incorrectly as tuberculosis of the hip-joint, and for this reason deserves mention.

Flattening of the head of the femur with thinning of the epiphysis and hypertrophy of the neck of the bone comprise the characteristic features.

Trauma, rickets, and infectious epiphysitis have been suggested as causes. The affection is one of the middle years of childhood.

The symptoms are slight lameness and moderate limitation of motion, particularly in rotation and abduction.

The diagnosis is confirmed by x-ray, which shows evidence of atrophic changes at the epiphysis with possibly thickening of the neck of the femur.

In most of the cases reported the symptoms have subsided under conservative treatment directed toward protection against weight bearing and overuse of the hip. Joint fixation is only exceptionally indicated.<sup>1</sup>

**Infective Osteomyelitis.**—The infecting organism in most cases of acute osteomyelitis is *Staphylococcus pyogenes aureus* which may gain access to the bone through the blood-stream from a remote focus or through direct extension from a nearby compound fracture wound.

The localization of this infection in the bone is attended by sudden onset of fever and pain. The pain is most intense and may involve the whole affected bone. Leukocytosis and general manifestations of sepsis supervene, and metastases of the organisms to other bones may occur.

The picture of profound sepsis which is not readily explained, even in the absence of pain, should always lead to examination for osteomyelitic foci. Rheumatism and typhoid fever may be readily excluded, even without the aid of positive x-ray findings.

Radical surgery combined with supportive measures of every available type, including transfusion, offers the only hope in these cases.

#### OSTEOGENESIS IMPERFECTA (FRAGILITAS OSSIUM; OSTEOPSATHYROSIS INFANTILIS; LOBSTEIN'S DISEASE)

This disease is characterized by multiple and repeated fractures of bones, particularly long bones.

Practically nothing is known of its etiology. The association of this

<sup>1</sup> Jones and Lovett, *Orthopedic Surgery*, 1923.

tendency to fractures in families whose members have blue sclerotics has been noted.

The bones show markedly defective calcification together with a paucity and inactivity of the osteoblasts so that the bony trabeculae are small and few. Multiple intra-uterine fractures are common, but most of these children are still-born or die shortly after delivery. Shortening because of fractures and bending of extremities in these newborn infants simulate chondrodystrophy. Roentgenograms of the bones show diminished density. The skull is parchment-like in consistency but, if the patient survives, later assumes a rather characteristic shape, broad and flat, sometimes with a projecting ridge of bone around the posterior and lateral aspects just above the level of the ears. The features are small in proportion to the head, with a rather sharp nose and a long pointed mandible. In the surviving cases fracture may occur from very ordinary handling and is difficult to prevent. Later, as the stumbling stage is passed and calcification becomes more complete, the tendency to fracture becomes less. The bones, however, often remain brittle and fragile throughout life.

There is no treatment beyond protection from trauma. Union of the fractures usually occurs quite normally.

*Illustrative Cases.*—A child, B. S., male, one year of age, was brought with a history of disability of the left leg dating back four weeks. There was no known trauma. The child had been born by cesarean section at which time the mother died. The history of development for the first eleven months was uneventful.

Roentgenograms of the affected leg showed a fracture of the middle third of the left tibia and later plates showed good repair with periosteal bone formation along the shaft. The epiphyseal lines were prominent and calcification of the shaft appeared less dense than normal. Typical blue sclerotics were present. Hemoglobin was 58 per cent. (Dare). Otherwise physical and laboratory examinations were in every way negative.

The mother of the patient had the following history of repeated fractures from trivial causes: At two years, complete fracture of tibia and fibula from falling one step; at four years, compound fracture of right ulna from stumbling to ground; at four and a half years, fracture of right malar and nasal bones from a blow; at eight, fractured rib from a blow of bicycle handle bars; at ten, fractured metacarpal and phalanx from a fall to the ground; at seventeen, a double fracture of the pelvis when falling from a horse. The mother did not have the blue sclera nor did another child, a sister of the first patient described.

This other child, P. S., female, also born by cesarean section, was a difficult feeding patient with secondary anemia. At one year, at two years, and at four and a half years she suffered fractures of long bones.

All the fractures in the three members of this family made normal repairs as regards duration and restored function. Other ascertainable family history was negative.

### CHONDRODYSTROPHIA (ACHONDROPLASIA)

Achondroplasia is a disease of fetal life characterized chiefly by defective development of the long bones.

The terms applied to this disease constitute a long list. Some of these are "fetal rickets," "micromelia," "chondromalacia," "fetal chondritis," and "chondrodystrophia foetalis."

Emerson<sup>1</sup> has cited many examples from Egyptian, Grecian, and medieval art, which go to prove the antiquity of this disease. He further states that of all dwarfs, those with this affection have been most popular in the positions of court clowns and jesters. The condition has long been

<sup>1</sup> Osler, Modern Medicine.

confused with rickets, cretinism, and certain types of syphilis. Parrot first made clear the pathologic distinctions in 1878, and Porak gave a very full account of the subject in 1890.

**Etiology.**—Heredity is an influential but not, apparently, an unfailing factor.<sup>1</sup> In many instances there is no family history of a significant character. Emerson has suggested that achondroplasia and rickets may be related, in spite of the usual variance in their manifestations and the evidence against the occurrence of so-called intra-uterine rickets. By many achondroplasia is thought to be due to defective function in one or more of the glands of internal secretion. Syphilis is sometimes associated with this affection, but cannot be said to be a cause.

**Pathology.**—The lesions are localized in the bones, more particularly the long bones and those of the base of the skull. The epiphyses are primarily affected. Here there is always defective formation of cartilage, whence the descriptive name, chondrodystrophy. Periosteal growth goes on, and, by invading the region which is normally supplied with bone by the cartilage cells, impairs still more the cartilaginous formation of bone, interferes with the union of epiphysis and diaphysis, and checks the growth of the bone in length. The irregular co-operation of the chondral and periosteal tissues in the development and growth of the bones similarly explains the actual deformities in their shape. Most of the cases belong to the type known as *hypoplastic*. The epiphyses are normal in size, and there is impaired growth of the cartilage cells. In the *hyperplastic* form, however, which is rare, the growth of cartilage exceeds the normal, and the epiphyses are enlarged. In *chondrodystrophia fœtalis malacia* the epiphyses are soft, due to decrease in the consistence of the intercellular matrix.

**Symptoms.**—The dwarf presents a peculiar appearance. To such a degree is this true that he is often a source of revenue. These individuals have normal intelligence, and being quick to turn their physical defects into pecuniary gain, they may often be seen on the vaudeville or comic opera stage doing minor rôles as foils to men of large stature.

The trunk is of normal size, while the extremities are very short. The head may be involved. It may be very large, showing a dome-shaped contour, not unlike that of hydrocephalus. The features may be large, with broad nose and prominent cheek bones. The forehead is usually wide, with the eyes set widely apart, due to the broad root of the nose. The facial appearance, as described, while usually present, is not necessarily a part of the picture. Cases are occasional in which the facial configuration differs in no wise from that of the general average of humanity. The muscles of the extremities, while short, are very large and strong, often affording these little people prodigious strength in lifting or carrying heavy objects.

The appearance of the child is characteristic, further, in that the hips are very heavy and broad, this appearance being produced in part by the peculiar articulation of the thigh with the trunk. The articulation takes place at almost a right angle, due to the change in the contour of the neck of the femur. There is marked lordosis, the lumbar curve being markedly exaggerated. (See Fig. 139.) This causes a tilting and narrow-

<sup>1</sup>See Prognosis, p. 800.

ing of the anteroposterior diameter of the pelvis, which in females may be a factor influencing childbirth in later life.

The hands are usually square, and the fingers very short. The feet take on the same appearance, being short and thick.

**Diagnosis.**—Chondrodystrophia may be confused with rachitis or cretinism in the first few months of life. Rachitis and chondrodystrophia have been confused, usually for the reason that chondrodystrophia is such a rare condition that it was not so generally known to exist.

The very short, thick extremities, together with the facial characteristics and normal mentality, are sufficient for a differentiation. Fur-



Fig. 139.—Chondrodystrophia.  
Lateral view.



Fig. 140.—Chondrodystrophia.

ther, the changes due to rachitis are of gradual development, and are never present at birth, while in chondrodystrophia the child, when very young, shows an appearance as characteristic as when he is two years of age or older.

Cretins are very degenerate mentally. They are slow and stupid, exhibit no mental responsiveness, and show but little irritation upon manipulation. In chondrodystrophia the mental condition is normal; at least those with chondrodystrophia cannot be placed in the class with the mentally defective.

**Prognosis.**—Our observation does not bear out the claim of a high infant mortality in chondrodystrophia.

**Physical Health.**—Of 5 supervised infants, all are well and thriving in their own way. One is the offspring of a mother who is a chondrodystrophiae. The father of another is a chondrodystrophiae.

Both men and women dwarfs have normal reproductive functions. Giving birth to children, however, is often a dangerous procedure for such women because of the anteroposterior narrowing at the pelvic brim and a tilting of the pelvis.

**Treatment** is of no avail, no means having been discovered to induce growth.

#### THE INFLUENCE OF DEFECTIVE BODILY MECHANICS ON HEALTH

It has long been our practice to try to improve the physical condition of our patients through the development of correct posture in the very young, and to correct abnormal posture in those that come to us for other causes. A great mistake is for the physician to feel that his duty to a child under his care is finished when he treats him for an illness.

It was through the writer's efforts for better body building in his earlier years that he came to appreciate that defective mechanics played a not inconsiderable rôle in the development of the child and often bore a direct relationship to persistent functional ailments of the gastro-intestinal tract in particular, sufficient to interfere gravely with the child's future health and bodily prosperity. The conditions of flat-feet, bowed legs, knock-knee, spinal curvature, and actual disease of bony structure have been admirably cared for by the orthopedist. The influence of posture upon physical function in children has, however, received scant attention.

The necessity for proper supervision of growing children has been emphasized by Robert J. Cook, who calls attention to the fact that among 1393 first year students at Yale University he found that but 25 per cent. of the men had a normal spinal curvature, that over 50 per cent. had some scoliosis, and that over 55 per cent. had an increased anteroposterior curvature. The chest was flat in 56 per cent. of cases and the abdomen was prominent beyond the normal in 42 per cent.

"Without an analysis of a large group of men it would be difficult to realize that poor posture is so common.

"When it is considered that those defects are found in men who have just completed their high school or preparatory school we become impressed with the seriousness. Living in a period when the cry is for preventive medicine one wonders why we wait until the individual is developed before an attempt is made to correct defects of posture which yield to corrective therapy so much more readily in the child than in the adult."<sup>1</sup>

In what constitutes a correct posture for a child there should be an equalized muscle balance. This is described by F. D. Dickson<sup>2</sup>:

"He should hold the head erect and directly over the chest, and hold the chest up in a forward position. The scapulæ should lie fairly flat

<sup>1</sup> New York Medical Journal, February 7, 1923.

<sup>2</sup> Jour. Amer. Med. Assoc., vol. 77, No. 10, p. 760.

against the chest and the shoulders be held back, without muscular strain. The spinal curves should be slightly convex backward in the dorsal region and convex forward in the lumbar region. The abdomen should be flattened and held up and in by the muscles. All the muscles of the neck, chest, back, shoulders, and abdomen should be in slight contraction without strain or effort."

The above quotation cited by Nicholson<sup>1</sup> presents a picture contrasting markedly with Nicholson's own description of the cases of abnormal posture as showing in varying degree the following:

"The chest flattened, with diminished anteroposterior diameters; the ribs approximated; the shoulders rounded and the scapulæ alar. The back has an exaggeration of the normal curves, and the abdomen is relaxed, owing to weak muscles, protruding markedly, especially below the umbilicus. The pelvis is tilted down and forward, and in many cases the knees are slightly flexed, as a compensatory measure."

Figure 141, A shows a boy who well fits the above description. In our attempts at improving posture and body mechanics we found that children so affected presented a very similar group of symptoms. As a rule they came to us not on account of the abnormal posture but because of some pronounced gastro-intestinal disorder of a chronic nature, such as recurrent vomiting, habitually poor appetite, or chronic and often obstinate constipation. Such patients usually suffer from secondary anemia. They lack ambition and initiative, they tire readily and constitute a considerable number of those whom we classify as subjects of tardy malnutrition.

For the past eight years we have been making a considerable x-ray study of the gastro-intestinal tract in children who have shown persistent gastro-intestinal disorders, as described at different times in medical literature.

The association of the ptosis position (Fig. 141, A) with gastropptosis as proved by the x-ray was striking. Not every child with gastropptosis or other defective gastro-intestinal mechanics has a faulty position, but almost every child with a pronounced faulty posture will reveal under x-ray either gastric or intestinal ptosis, or both. Unquestionably, there are children who have ptosed stomachs, V-shaped colons, and elongated sigmoids who do not have faulty posture or relaxed abdominal walls. It is these who are the least likely to show symptoms, as strong abdominal muscles supply the necessary support to compensate for the abnormality.

The writer has previously called attention to the use of abdominal support in treating ptosis in children, and can only reiterate with added emphasis that the most useful individual measure that applies to all types of ptosis, both of the stomach and intestines, is the use of proper abdominal support. For the average case of ptosis the Aaron belt, with or without shelf, as the case may require, answers our purposes satisfactorily. For the posture cases we were unable to find a suitable support until our attention was called to the Universal supporter as described by Nicholson (Figs. 142-144). In this device we have support for the relaxed abdominal muscles, a splint for the lordotic spine, and a brace for the sagging shoulders, all of which are due in a measure to weak muscles. The digestive organs are thus held in better position and the stomach

<sup>1</sup> Penna. Med. Jour.

empties better and "on time." Sharp angulations are removed from the intestine and constipation is consequently made easier to manage.

Mechanical assistance with a suitable dietetic régime, adequate rest, and right exercise not only produce a rapid and marked change in the physical well-being of a patient but also rapid gain in weight.

*Illustrative Case.*—Our most pronounced example of a case of this type is significant. The patient (Fig. 141) presented one of our worst cases of celiac disease.



Fig. 141.—The Nicholson supporter: Effect on posture apparent on comparing A and B.

At the age of three and a half years his weight was 22 pounds and he was emaciated to a skeleton, with an enormous belly and marked muscular atrophy. Tetany developed and was very troublesome. Calcium chlorid appeared to control this, but was found necessary for months. During the next year there was a very irregular gain in weight with never a cessation of the characteristic loose, excessively large, rancid stools to the number of perhaps two or three daily. Varying diets and schemes of management were tried, with little or no improvement. There were two attacks of scurvy during this time. For two years the boy was unable to walk. An abdominal belt had been worn intermittently without any pronounced effect.

On November 11, 1922 his age was five years and one month, his weight was 26½ pounds, and his height, 36 inches. The weight was 7 pounds less than at the onset of the illness when he was two years and seven months old. On the above date we decided to supply a Nicholson supporter, but this was not brought into use for six weeks. On February 21, 1923 his weight was 28 pounds, 9 ounces, a gain of 2 pounds, 5 ounces having been made after the brace had been brought into use. Then, for the first time in his illness, the mother admitted improvement. His disposition was much better, he wanted to play and was trying to walk in spite of the fact that he made a very poor showing. His position was, nevertheless, better, although the abdomen was still very much distended. The stools now showed an improvement in that there were days when they were fairly normal; then there would be characteristic celiac stools for a day or two. On May 19, 1923 his weight was 33¼ pounds and his height was 37½ inches. Walking had improved but he could not go upstairs unassisted or pick up objects from the floor. As there was still a tendency to tetany, calcium chlorid was continued. A mixed diet was now taken suitable for a child of his age.

On August 25th the mother reported the height 39 inches and the weight 38 pounds. During the three weeks preceding her report he had gained 3½ pounds in spite of an attack of whooping-cough. At this writing he is on a general mixed diet. He still

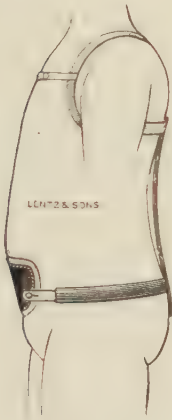


Fig. 142.

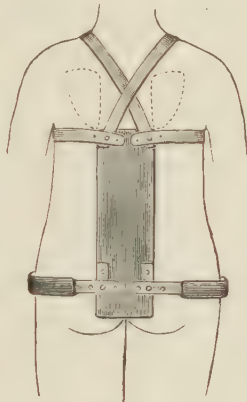


Fig. 143.

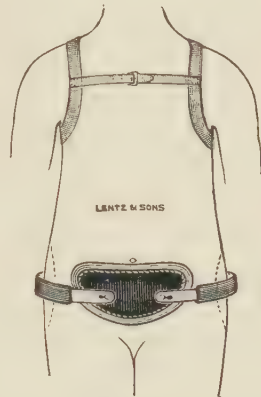


Fig. 144.

has some difficulty in walking and cannot run, but can pick things from the floor and go upstairs. The posture is better and he is very comfortable in the supporter and asks to have it replaced when it is taken off.

The cuts show the posture and general position tremendously improved. The lordosis and the large abdomen still persist, and the supporter will have to be worn for a couple of years.

The mother is insistent in stating that no food agreed until he began to wear the abdominal support with which he is represented after a gain of about 10 pounds.

Our results with the Nicholson supporter have been, on the whole, satisfactory. From our observation we believe that Nicholson's claims are not exaggerated that the supporter aids in producing an improved posture, with a resulting correction of gastro-intestinal mechanics, and that its use is followed by greater improvement in persistent gastro-intestinal disorders than the measure would at first estimate seem to warrant.

## XXII. MISCELLANEOUS SUBJECTS

### HEREDITY AND ENVIRONMENT

MANY of the diseases, crimes, and failures of life are attributed to heredity, as are also vigor of body, attainments, and successes. Heredity and environment are two important determining factors in the life of the child. Both exert their influence over the individual. Most of us have been taught, or in some way conceived the idea, that the influence of heredity was predominant; but as a result of the closest association with developing children involving intimate relations with hundreds of them essential to watching carefully their physical and mental development, the great influence exerted by environment, which often means only opportunity, is forced upon one. This relegates heredity to the background. That certain diseases, such as syphilis and hemophilia may be transmitted from parent to child is undisputed; that certain physical states—the so-called constitutional vices—may also be transmitted is indisputable; but that much of natural physical weakness and hereditary tendencies may be overcome by the beneficial influence of environment is now universally acknowledged. Place a child or one of the lower animals, with an ideal heredity, under unfavorable conditions of environment and the favorable heritage counts for little. Feeding, and general good management shape physical future much more than care, does inheritance. In proof of the supposed inheritance of mental traits, offspring of criminals or drunkards are pointed out as showing how children follow in the footsteps of their fathers and mothers. It must be admitted that here the hereditary influence is bad, but one should remember that the environment has also been very unfavorable.

Mental traits much more than physical conditions are apt to have an influence on the progeny, although here, again, brilliant fathers rarely transmit their higher mental powers to their offspring, as is proved again and again in the professional and business world. Many of the ills laid at the door of heredity are due to errors in early management. In the breeding of animals great stress is laid upon pedigree, and credit is given accordingly. It should be remembered, however, that the stock-raiser appreciates the value of the young of his herds, and they invariably get the care that is best calculated to develop the perfect animal, which is exactly what the majority of the children of the human family do not get. A well-bred animal, treated from birth to maturity as are many children, would cut a sorry figure in the animal world.

Hereditary influences in animals are much more apt to obtain because of the comparatively short period of growth from infancy to maturity. The age of puberty in the lower animals is reached in most instances before the first year. In the human the development is much slower, supplying a much longer time for the influences of environment to make their impress upon the individual.

## CONSANGUINITY

Much has been made of the supposed unfavorable influences exerted upon the offspring by parents closely related by blood. Consanguineous marriages, however, exert very little influence on the progeny if both parents are in good health and there is no latent familial defect in either.

If, on the other hand, there is a decided family taint or weakness the tendency toward this weakness is inevitably exaggerated in the offspring of two persons in whom the trait is dominant. The outworking of this law may be observed in a study of the transmission of such defects as color-blindness and hemophilia.

The writer has known first cousins to marry and have children in all respects normal, and in two instances under his observation fathers had impregnated their own daughters, with normal children the outcome. Similarly, in the animal world the close breeding of brothers and sisters and parents and offspring has resulted in normal vigorous young.

Doubtless if this in-breeding were continued through successive generations the outcome would be disastrous because of the establishment of a hereditary uniformity of type with certain unbalanced potentialities.

It is practically important that, whereas the laws of heredity impose fixed general principles, these principles are of broad scope.

## TEMPERATURE IN CHILDREN

**Normal Temperature.**—The question is often asked: What is the normal temperature of a baby or young child of a given age? In order to answer this question from direct observation, a study of the matter was carried out by Dr. H. G. Myers, resident physician at The New York Infant Asylum. This study comprised 59 cases, the ages varying from birth to one year. Only well children were selected for the observation, the majority being breast fed. The temperature in each instance was taken by the rectum for four minutes.

It was found that the birth temperature in these infants ranged from 96° to 98° F., exceeding 98° F. in but 5 cases, when it was between 98° and 99° F. In one it was 94° F. During the twenty-four hours following birth there was a rise in the temperature usually of about one degree. From this time on there was little variation in the temperature, when the child was well, regardless of the age. There would be a variation at different times of the day of a fraction of a degree, the temperature being higher in the evening. Upon looking over the charts upon which the results were chronicled, one is impressed by the uniformity of the temperature, which ranges, within fairly narrow limits, from 98° to 99.2° F.

Instances when the temperature arose to 99.5° F. were occasionally seen, but 100° F. was very unusual. It is not claimed that the temperature of a well child may not reach 100° F., in fact, there were occasions when it rose to 101° F. and illness could not be proved, and had not the temperature been taken for the purpose above mentioned, no elevation would have been suspected, for the next reading was normal. In those cases in which a rise was proved to be an early sign of illness, the special temperature record was discontinued and the first reading was not in-

cluded in the observations. In one child a temperature of 103° F. was found. It remained at this point for three hours, when it fell to normal without any other manifestation of trouble. When, however, the thermometer registered over 99.5° F., some cause for the elevation could usually be discovered, though it may have been nothing more than excitement or slight indigestion.

Several years ago a similar series of observations was made at the Country Branch of the New York Infant Asylum upon 25 healthy children under eighteen months of age. The temperatures were taken four times a day, the observations extending over an entire week. It was found that in these well children the temperature varied from 98° to 99° F.; and that when it rose daily above 99.5° F., some abnormal condition was always found.

From these observations upon 74 well children, ranging in age from birth to eighteen months, whose temperatures were taken several hundred times, it would seem that a daily rise above 99.5° F. may be considered abnormal. An occasional rise, however, considerably higher than this, as above mentioned, may occur and does occur in perfectly healthy children, without any special significance.

**Fever.**—By fever we understand an increase above that which is considered the normal body temperature.

In children, for clinical purposes, the rectal temperature should always be taken. With those under five years of age the mouth observation is unsafe, because the child is apt to bite off the thermometer bulb, and unreliable, because the lips will not remain closed the requisite three or four minutes. The axillary temperature is thoroughly misleading and should never be depended upon. One-minute thermometers are often unreliable.

**Hyperpyrexia.**—The highest temperature personally known to the writer, and not due to sunstroke or insolation, was 111° F. This was as high as the thermometer could register.

This extreme fever occurred in a child of ten months who was in a convulsion which was one of the first symptoms of tuberculous meningitis. The child had been placed by the parents in water at a temperature of 115° F., and had been in the water about ten minutes before the rectal temperature was taken. How much the temperature was due to the illness and how much to the hot water will never be known. The temperature responded promptly to a cold bath. The child never regained consciousness and died of meningitis ten days after the initial convulsion.

**Fever as an Indication.**—Fever may or may not be an index of the gravity of a disease. Thus we frequently see a temperature ranging from 103° to 105° F. in tonsillitis, acute indigestion, and stomatitis—ailments which respond very quickly to treatment and which present no serious aspects. In typhoid fever, pneumonia, scarlet fever, and diphtheria, however, when the temperature range is above 104° F., it is a symptom of considerable value, as indicating the severity of the infection. It is, therefore, not the fever itself, but the condition back of and associated with it, which makes it a sign of clinical value. In pneumonia children bear a comparatively high temperature, 104° F., for example, without much discomfort or danger; while in the acute intestinal disorders of summer an equal degree of fever is borne very

badly, and if continued is of grave significance. These considerations must be kept in mind in our dealings with fever.

**Importance of Fever.**—When is a given temperature to be interfered with? This question concerns all practitioners. The answer depends to a great extent upon the cause of the fever and its effects upon the patient. If the fever produces diminished assimilation, loss of sleep, irritability, and restlessness, it will do the child harm by diminishing the normal resistance to disease, and should be relieved whether it is  $102^{\circ}$  or  $105^{\circ}$  F. Interference is thus dependent not so much upon the height of the temperature as upon its effects upon the patient.

**Methods of Relieving Fever.**—*Elimination.*—This applies particularly to the gastro-enteric tract and the skin. In a majority of the cases of high fever due to acute indigestion with resulting toxemia, purgation, bowel washing, and a carefully adjusted diet for a day or two secure recovery. We remove the cause of fever, and the fever subsides. Unfortunately, this means of controlling fever is limited to disorders of the gastro-enteric tract.

*Hydrotherapy.*—By far the most satisfactory means of controlling fever is the local abstraction of heat by means of sponging (p 840), tub-baths (p 843), and cool packs (p 841).

*Antipyretic Drugs.*—Much which borders on the sensational has been written about the harmfulness of antipyretic drugs, particularly the coal-tar products. Used in large and frequent doses, they certainly may do a great deal of harm. Under certain conditions, if used in small doses and repeated at intervals of from three to six hours, these drugs may be, and often are, of benefit. Aconite and liquor ammonii acetatis are of some value, as above stated, but they are of little value in controlling a very persistent high temperature. The coal-tar products furnish the best antipyretic drugs, and these may be used with safety, but should be used only when, for any reason, the abstraction of heat by the application of cold is impossible. In many families there is too little intelligence to make a cold pack either possible or safe, while in severe cases of pneumonia, scarlet fever, and the intestinal diseases, sponging often will not answer. Sponging and tub-bathing, if repeated too frequently, particularly during the night, exhaust the child. Moreover, these procedures are often strenuously objected to by parents as well as by the patient, and if the nurse is one of the family, her sympathy will counterbalance her judgment, and the result be far from satisfactory. Under such conditions, when the application of cold to the skin is impossible, a combination of phenacetin and caffeine, alone or with Dover's powder, has proved effective. The antipyretic treatment of scarlet fever is the same as that of pneumonia or typhoid fever.

To a child of one year, 1 grain of phenacetin with  $\frac{1}{4}$  grain of citrate of caffeine may be given and repeated at three-hour intervals if the temperature requires it; to a child two years of age  $1\frac{1}{2}$  grains of phenacetin and  $\frac{1}{2}$  grain of citrate of caffeine at three-hour intervals; three years and over,  $1\frac{1}{2}$  to 2 grains of phenacetin with  $\frac{1}{2}$  to 1 grain of citrate of caffeine, at intervals of from three to six hours. If there is much restlessness and irritability, which is not thus controlled, Dover's powder may be added— $\frac{1}{4}$  grain to each dose, for a child of from three to six months

of age:  $\frac{1}{2}$  grain between six and twelve months; 1 grain after the age of two years is reached. It is always wise to caution parents as to the use of Dover's powder. They should be told that if the child becomes "heavy" or unusually sleepy, the powders must be discontinued. That phenacetin and citrate of caffeine cannot be given in solution is unfortunate. Like all insoluble powders, they are best given in some mucilaginous mixture, such as barley-water or one of the cereal jellies. Fruit juice or apple-sauce usually answers well. Antipyrin, for the reason that it forms a tasteless mixture with water, succeeds well with some intractable children, and may be used in the same doses as phenacetin, although as an antipyretic the antipyrin is less efficient.

### OBSCUR ELEVATION OF TEMPERATURE

Perhaps the most annoying cases in pediatric work are those with an elevation of the temperature for which no adequate cause can be discovered. In the section on Normal Temperature (p. 805) certain possible variations are given which are regarded as within the limits of health. When these boundaries are passed, when there is a temperature range between  $99^{\circ}$  and  $101^{\circ}$  or  $102^{\circ}$  F., or a temperature persistently at  $100^{\circ}$  or  $101^{\circ}$  F., without any apparent cause, and continuing for days and weeks, the medical adviser is not in an enviable situation. Such cases are sometimes easy of solution. At other times, however, the cause of the fever may never be discovered, and the patient eventually gets well, leaving us still in ignorance of the cause.

**Active Exercise in Nervous Children.**—This is not infrequently the cause of an elevation of the temperature.

*Illustrative Cases.*—*Case 1.*—A country child three years of age, whose temperature every afternoon at 1 o'clock was  $102^{\circ}$  F., while not vigorous, showed no signs of illness. He ate well, slept well, and played hard. There was a slow gain in weight. The fever was discovered by the mother, who thought that the child, who was a blonde, looked flushed every day at about the same time. The temperature by rectum was normal in the morning and normal at night. This condition, to the attending physician's knowledge, had persisted for six weeks before the writer saw the patient. How long there had been a daily elevation of the temperature above the normal before the mother discovered it we have no means of knowing. The family doctor, an excellent practitioner, had suspected, examined the child for, and treated him for, various diseases; at first for malaria, with no response to quinin; then typhoid fever, as by suggestion and constant inquiry the child came to imagine that he must be sick, and complained of languor. The fever continued, however, beyond the usual time allowance for typhoid fever and there were no other symptoms. There was no enlargement of the spleen and the blood had been repeatedly found negative to the Widal reaction. Other possible causes of the fever were also given attention. One day the doctor suggested tuberculosis. This aroused the family and friends and a consultation at the child's home was the immediate result.

A rather thin boy three years old was presented. The family history was excellent. There was one other child, six years of age, who was a good specimen of robust boyhood. The patient had never had a pulmonary disorder and no disease of the respiratory tract other than slight bronchitis. There was no apparent association of the condition with any intestinal or infectious disease. An exhaustive physical examination failed to reveal any abnormality other than a small umbilical hernia and a slight enlargement of the inguinal and submaxillary glands. The blood was not examined. The child was pale, and doubtless a blood examination would have revealed a mild secondary anemia. The appetite was fairly good; the bowels were reported regular and the stools normal. The child had not been kept in bed, as the family did not consider him very ill. After the negative physical examination the mother was questioned very closely as to the child's habits of life.

He rose at 7 A. M., had breakfast at 7.30, and played with his big brother and two older boys until 1 o'clock, when he had dinner. A glass of milk and a piece of bread and butter were given as a luncheon at 11 A. M. He played very actively, kept up with the older boys, and was unhappy when he was not with them. Attempts had been made without success to entertain him with less strenuous play. It was at midday, sometimes before, sometimes after dinner, that the temperature reached the highest point. It seemed, therefore, that here, probably, was a case of fatigue temperature. Accordingly, it was suggested that the boy be undressed and put to bed at 11.15 A. M. after the light luncheon and be made to rest and sleep if possible. At 1.15 P. M. he was to be taken up for dinner, his temperature first being taken. These instructions were faithfully carried out, and this ended the daily rise in temperature. The case was one of an active, nervous child becoming overtired in his attempts to hold his own with older and stronger boys. The patient improved rapidly in his physical condition and after an interval of several years was still perfectly well.

*Case 2.*—Another child, four years of age, was seen in consultation because of a daily elevation of the temperature ranging from 100° to 102.5° F., which had continued for six weeks. The child was thriving and otherwise perfectly well. No cause for the fever could be discovered in his physical condition. He had a noisy, excitable nurse, who was inclined to exciting games and rough play. With dismissal of the nurse the fever ceased.

**Otitis.**—Persistent fever, following the acute catarrhal affections of the upper respiratory tract and the exanthemata, is sometimes explained by a suppurative process in the middle ear, without other symptoms than the fever.

**Encysted Empyema.**—A small focus of encysted empyema may explain a persistent fever following pneumonia. Holt described a most interesting case of this nature in which there was for over four weeks a temperature range from 100° to 105° F. Autopsy showed a small collection of pus between the diaphragm and the lung.

**Periodic Fever.**—Not infrequently we see cases which show clinical signs of malaria as regards periodicity in the temperature, but without splenic enlargement or the presence of the malarial organism in the blood. Yet, often, these cases quickly respond to full doses of the bisulphate of quinin.

**Typhoid Fever.**—Occasionally a low persistent temperature elevation, obscure for a week or two, proves to be due to a mild typhoid.

**Tuberculosis.**—An elevation of the temperature is sometimes the first premonitory symptom of tuberculosis. Tuberculosis in a child is usually an active process when it involves the lungs, and can readily be made out. When other parts are involved, such as the bones, glands, skin, or peritoneum, the manifestations are usually also sufficiently plain to indicate the condition.

More obscure cases of persistent slight elevation of the temperature have been explained by an *infection of the mediastinal glands*. The temperature is usually not high (99½° to 101° F.) and is most pronounced after activity.

*Illustrative Case.*—Recently 2 children came under observation, aged two and four years. The temperature in one case had continued for three months. In the other there had been an unexplained indefinite temperature for longer or shorter periods for over a year. Both patients showed by x-ray evident tuberculous infection of the mediastinal glands.

In confirming the diagnosis of concealed lymph-node tuberculosis the x-ray is invaluable.

*D'Espine's Sign.*—In 1907 D'Espine described a sign which he considered diagnostic of enlargement of the bronchial lymph-glands, irrespective of the cause of the enlargement. This sign consists simply in whispered bronchophony in the interscapular space and may be present in cases of leukemia, Hodgkin's disease, syphilis, and other infectious diseases than tuberculosis. According to D'Espine the transmission of the whispered voice normally ceases at the level of the seventh cervical spine posteriorly.

Transmission of bronchophony below this level is very strongly suggestive of tuberculous involvement of the mediastinal lymph-glands.

In making the actual test the examiner applies his stethoscope firmly in the interscapular space at varying levels as the patient says, "three-thirty-three." When the sign is definitely positive the final "e" persists like an echo after the actual whisper is terminated.<sup>1</sup>

Morse, from a study of "D'Espine's sign in childhood,"<sup>2</sup> concluded that the change in voice normally occurs at a level between the seventh cervical and first dorsal spines.

This study was based on 666 patients of the better class seen in private work, and in this group the sign was found positive in only 6 per cent. Analysis indicated that in half of the 6 per cent., the glandular enlargement was not tuberculous.

It is the consensus of opinion of many observers that in the diagnosis of tuberculosis D'Espine's sign is of undoubted value but should be considered not alone, but in conjunction with other physical signs and symptoms.

**Intestinal infection** due to chronic constipation may be the cause of persistent fever. In a suspected case, in the absence of bowel symptoms, it is well to give a laxative and put the child temporarily on a reduced diet consisting largely of carbohydrates.

**Pyelitis** of mild degree may produce a slight elevation of the temperature, which may be difficult of solution. Several specimens of the urine may fail to reveal pus. In doubtful cases the urine should be drawn by a catheter and examined by culture methods.

**Unexplained Elevations of Temperature.**—Children exhibit an unexplained temperature of from 100° to 101.5° F. for weeks, without any other signs of illness. One may employ all the newer diagnostic laboratory methods, and still see such patients recover without a diagnosis. Of one thing, however, we may rest assured: If a competent, thorough examination does not reveal the cause of the slight fever we are safe in concluding that there is nothing of very serious nature back of it.

The fact that milk does not agree with a child may mean that the child is mildly sensitized to cow's milk protein and reacts accordingly with a moderate fever.

Periodic attacks of elevation of the temperature from 101° to 104° F., explicable only on the grounds of a disturbed metabolism, are occasionally encountered. Except for the finding of acetone in the urine these cases are negative throughout. The pyrexia lasts four or five days and then subsides by crisis. The acetone is not the result of starvation, and the case is not one of true acidosis.

<sup>1</sup> Stoll, H. F., Amer. Jour. Dis. of Child., 10, 1915, pp. 183-193.

<sup>2</sup> Amer. Jour. Dis. of Child., 11, 1916, pp. 276-280.

*Illustrative Case.*—The history of a case of this kind, which gave no end of trouble and annoyance, may not be without interest.

The patient, an eight-year-old boy, was the only son of a habitually anxious mother, who had unfortunately learned to use the clinical thermometer. She took her boy's temperature after school one day early in December and found that the thermometer registered 100.5° F. The writer was consulted, saw the boy in the evening, took his temperature by mouth, with his own thermometer, and found it 100.8° F., with no other evidence of disease. The boy was perfectly normal in every other respect. He maintained that he felt well, did not need a doctor, and wished to be let alone to study his lessons. The following morning the temperature was 100° F.; in the evening it was nearly 101° F. For six weeks this temperature range continued, never below 100° F., never higher than 101.2° F. Finally the mother became reconciled to "doing nothing" for her son, and he was taken to a nearby winter resort. The boy had an excellent time at the winter resort, played with his sled in the snow, skated on the lake, and fell through the ice once and received a thorough wetting, without harm. In three weeks he returned, improved as much as any city child improves from a country outing. His temperature was not taken during these three weeks at the winter resort and has not been taken since, except when there have been evidences of illness.

### NEUROCIRCULATORY ASTHENIA (EFFORT SYNDROME)

There is but one classification of normal children and such are supposed to be of the same physical and mental capacity. Two ten-year old boys may be equal in general intelligence as shown by the Binet-Simon test, yet one will be able to accomplish much more than the other in a given time. There is no mental test for initiative, incentive, or mental endurance. Because of the lack and the difficulties of an adequate classification not a few children are placed at a decided disadvantage. The capacity for continued effort, which means the ability to work, counts for just as much as does the spontaneous intelligence that the child may possess.

It has long been our observation that children divide themselves into groups as relates to individual ability for effort. This tendency to grouping is not discernible to any extent among infants. After the second year, however, individual traits and a distinct personality manifest themselves. At about this period it may be said that the child begins to individuate.

During the late international war, English Army surgeons learned that, when certain recruits were put to prolonged hard work, at drill, hikes, and other exertion, they failed to measure up to the endurance standard required of a soldier in the field. Although these recruits had passed the various physical tests and had been put to training, after a time it was found necessary to disqualify the men because of their inability to perform the duties and bear the hardships demanded, which others were able to meet. To this condition Dr. Thomas Lewis applied the term "effort syndrome." As the most prominent symptoms involve the circulatory and nervous system, later writers have used the term "neurocirculatory asthenia" or "neurocirculatory myasthenia" (MacFarlane). This condition in healthy individuals, Lewis qualified by the term "constitutional."

Friedlander and Freyhof<sup>1</sup> reported on 50 cases of so-called "constitutional neurocirculatory asthenia."

Robey and Boas,<sup>2</sup> after an intensive study of a large number of soldiers

<sup>1</sup> Arch. Int. Med., December, 1918.

<sup>2</sup> Jour. Amer. Med. Assoc., August 17, 1918.

suffering from neurocirculatory disorders, were obliged to recommend for permanent discharge 87 per cent. These cases all belonged to the so-called "constitutional" class.

The boy or girl who may qualify for the diagnosis of neurocirculatory asthenia comes to us with a typical story, which, condensed, is that the child is bright and responsive but lacks capacity for sustained effort, both mental and physical. It is stated that the child is intelligent but cannot apply himself sufficiently to become an average student and is behind in his classes. In like manner he is physically unfit for the usual activities of boyhood. He tires readily and prefers to be a spectator rather than an active participant in games and other amusements. Wherever endurance is required he fails. If he attempts in later life to make the football or baseball team, he is "turned down" by the coach or trainer. Nevertheless he is not ill, and even upon a thorough physical examination will fail to show disease. One of the distinguishing characteristics is a lack of nervous control. The weight and height apparently have little to do with the condition. In the writer's case records the child of this type has been heretofore classified as a "poor individual."

The individual boys and girls of this type are subjected to a good deal of unjust criticism. They are accused of being lazy, indifferent, careless, and dull. The fact is they are poor types of human machines of from 50 to 75 per cent. working capacity. It is important not to confuse these young people with those who suffer from bad habits, as regards their sleep, rest, and general hygiene, or with those who are bodily ill, or with those who, because of rapid growth and arduous duties, are temporarily but not permanently below normal. It may readily be understood that in girls such constitutional peculiarities may attract less attention and be more readily excused when present.

With suitable management in all such cases there will always be a sustained response.

*Illustrative Cases.*—*Case 1.*—A young man now twenty-three years of age came under the senior author's care at the age of six months. He was the oldest of 3 children and the only boy. The father was in fair physical condition. The mother was delicate in the sense that she had very little resistance or stamina. Frequent rest cures were necessary. She had backaches and headaches habitually, was nervous, thin and pale, and always had been a care to her parents.

The boy had the usual illnesses of childhood and suffered considerably from digestive disturbances in the early years. He was irritable at home and rather unhappy in school. His school life proved very strenuous and was interspersed with frequent intermissions for one cause or another. Mental control was defective. Tantrums were not unusual. As he grew to older boyhood, various boarding schools were attempted, but he never remained longer than the Christmas vacation. It was uniformly found by the head master that the school was not suited to the boy.

When the United States entered the war he volunteered in a certain department and was accepted, passed the physical examination, remained a few weeks, and then was assigned to another division of the service. Thither he went, and was examined and again accepted, but in a short time was advised to apply to another department. Again he was accepted and again he failed. The boy was anxious to enter the service as all his friends had volunteered and 2 younger sisters made his life miserable by their anxiety to have a big brother hero.

It was absolutely impossible for this boy to do the work required of him in any of the positions he attempted, although he was most anxious to serve.

(These individuals finally drift into the right occupational sphere, one that requires very little expenditure of effort.)

*Case 2.*—A boy who was a fine physical specimen was frequently ill in early boyhood but never seriously ill. He had a tendency to be introspective and moody. He

did not like school and could not get along very well with other boys. His school attendance was interrupted by headaches, attacks of indigestion, and various nervous disorders, particularly hysteria and "brain storms," all of which were produced by mental concentration. When he was twelve years of age he was ashamed to go to school, because he was so far behind others of his age. With private tutoring he was able to enter the primary department of a large boy's school at the beginning of the autumn term, but just before the Christmas holiday, the mother had a letter from the head master telling her that in his opinion their particular school was not suited to the requirements of her son.

Work in the garden produced dizziness.

As a young lad he would ride his bicycle down hill two miles to the village and pay some public conveyance to take him and his bicycle home.

He is now a well-meaning, well-spoken, kindly disposed young man, without a trace of initiative. He has tried very hard to be a real boy, but confides that he cannot and the attempt has caused him a great deal of worry. Endocrine treatment was of no avail. Thousands of dollars have been wasted on him to date.

The mother was forty-eight years old when the boy was born, and the father, fifty.

*Case 3.*—A young man of twenty years is still in school preparing for college. The writer has known this boy since he was an infant, and has exerted all possible influence to have the boy give up the college idea and go into business. His friends are all in college and there only will he be happy. He enjoys fairly good health, but has never been known to take part in any sport. He prefers to be a spectator. Exertion makes him nervous and any unusual event causes him to remain in bed the next day. He is totally devoid of initiative. He is very intelligent and most ambitious until he starts to do some thing that requires effort and then he falls "flat." The mother of the boy is a habitual invalid, but is never very ill. The father is an unusually able business man.

*Case 4.*—A girl, eighteen years of age, large, well-formed and mentally alert, is in school about half the time. She has frequent headaches and backaches and tires easily. Other girls make her nervous. Parties tire her. An evening of dancing could not be considered. The girl is normal physically and has been examined and treated by a goodly number of physicians, with gland therapy and otherwise. The writer has known her since she was two years old. She always has been, and always will be, useless at any undertaking that requires effort.

These few cases are given simply as illustrative of the type. Similar cases and others less pronounced exist in all communities, and all have one feature in common—a lessened capacity. Rest cures, change of climate, and various supporting measures are of little avail. As these individuals are fashioned, so they remain; a most discouraging group.

The poor individual exists throughout the entire animal world. Among the lower animals, those of defective capacity, for economic reasons, usually have a short career. The defectively functioning human, if well-born, is urged and forced and stimulated to accomplish that which is not in him. *It is impossible to get out of any piece of machinery, work which the machine was not intended to accomplish.* Millions of dollars are wasted on youths who are physically and mentally unable to meet the standard set up by ambitious parents and friends, in an effort toward their so-called higher education. The highly trained teaching talent of our preparatory schools and universities is wasted in part on poor student material, 25 to 50 per cent. of which should be scrapped and put to productive occupation. Before a boy is permitted to avail himself of unusual educational advantages it should be determined *that he is worth it.* The high school and the preparatory school should serve as a clearing house. In addition to the examination attainments required for a college entrance it should be required that a candidate submit testimonials as to physical fitness and mental capabilities from the head master or high school principal. What is needed, for economic reasons, is expert occupational diagnosis by men who will aid in placing the boys at work to which they are fitted.

The writer has had the opportunity to keep in touch with a great many boy patients through manifesting an interest in them, and has been able to advise and assist them along occupational lines. A boy who belongs in the class we are discussing should discontinue school in the fifteenth or sixteenth year and take up business.

In order to permit of a reasonable success, the occupation must be one that is not strenuous. Such boys often make fairly good salesmen, clerks, and bookkeepers. They never get very far, however, as they belong to that considerable class who watch the clock. Advancement in salary, partnership and other promotions go elsewhere.

It is exceptional to find children of this type the offspring of strong, vigorous young persons. In a great majority of the cases they are the offspring of weakly mothers, the women of little resistance and of lessened endurance capacity. A strong vigorous mother will do much to offset the unfavorable influence on the progeny of a weakly male. The progeny of vigorous males is, on the other hand, greatly handicapped by inferior mothers—all of which applies to the lower animals as well as the human individual.

Frequent child-bearing has apparently been a factor in some instances. By far the chief cause, however, for the "50 to 75 per cent. individual" is a mother of lowered resistance, of inherent weakened constitution, and inability for sustained effort—which defects she transmits to her offspring.

The need for a great deal of attention to the physical development of those who will some day be mothers is very urgent.

**Comment.**—There are constitutionally inferior "substandard" (MacFarlane) children. Thus constituted, they enter the world and thus they continue throughout perhaps a long life regardless of attempts at improvement. A trait common to all is inability for sustained effort. Physicians, educators, and all others interested in the development of the young should appreciate that what often passes for indifference, indolence, and inattention may be of constitutional origin and impossible of correction. When such is found to be the case, the child's curriculum should be made to fit the child; and not the child to fit any "cut-and-dried" curriculum. All attempts of the latter class mean wasted energy.

#### ANAPHYLAXIS

The second introduction of a soluble foreign protein at an appropriate interval after the first introduction of that same protein causes a train of symptoms designated by the term "anaphylaxis." The first dose sensitizes the organism, while the second dose intoxicates. The time required for sensitization may be ten days or longer, and its duration has been found to be as long as seven years.

The therapeutic use of immune sera, the majority of which are derived from horses, gave rise to anaphylactic phenomena which von Pirquet and Schick recognized and called serum disease. Some patients react after a first dose of serum, the symptoms appearing eight or ten days after its injection, and consisting of fever, skin eruptions, muscle and joint pains, and glandular swellings. Such patients, after the ad-

ministration of a second dose, develop symptoms after a few hours or only after several days. The immediate reaction is characterized by a local edema at the site of the injection, increasing slowly for twenty-four hours, and then disappearing in two to five days. Fever and skin eruptions are also present, and in a small percentage of cases nausea, vomiting, and even collapse may occur. When the symptoms are delayed for several days, they usually occur suddenly and disappear within a day. They are similar to those following the injection of the first dose of serum.

In individuals who are asthmatic or afflicted with an idiosyncrasy to the odor of horses, a first dose of horse-serum may cause an attack of respiratory distress with cyanosis, or else cardiac weakness with a fatal ending. In such cases we must assume that the sensitization was either inherited or acquired through the lungs or through the stomach. Experimental data support all three assumptions.

The tuberculin reaction is a local anaphylaxis in individuals sensitized to the proteins of the tubercle bacillus.

Hay-fever is a local anaphylaxis to the protein constituent of certain pollens.

Drug and food idiosyncrasies are anaphylactic in character.

**Allergy to Cow's Milk.**—It is probable that the future will disclose that our trouble in cow's milk feeding is dependent in greater or less degree upon a sensitization to cow's milk protein. Several years ago the senior author nearly killed a baby in his office by placing on his tongue 5 drops of cow's milk. When reactions of such severity occur and when the skin of an infant reacts to an infinitesimal amount of cow's milk protein by the formation of a large wheal it is fair to assume that there are numerous other cases of susceptibility to the foreign protein in which the allergy, although less pronounced and perhaps not easily demonstrable, is still an important factor.

We are still on the threshold of knowledge of a vast number of cell reactions to foreign substances. When fresh cow's milk disagrees we substitute usually a cow's milk product which has been subjected to heat or drying. Thus, evaporated milk and dried milk have been used for years in feeding infants for whom fresh milk proved intolerable. The explanation of the success achieved in such cases lies in the fact that through the use of heat, drying, and other processes the particular toxic element in the protein in question has been changed or destroyed so as to remove its power for harm.

## NEW GROWTHS

**Carcinoma** in children is of very unusual occurrence. We have seen but one case of carcinoma in a child. The lung was the site of the growth.

Phillipp collected 390 cases of carcinoma reported in children under fifteen years. Among these he found but 87 which were undoubtedly true cancers. To these he added 6 cases, making 93 cases of cancer in childhood. This report was published in 1907. In 1911 Ribbert stated that no other cases had come under his notice, so that about 93 cases of cancer (real) had then been reported in children. Three-fourths of these occurred in older children, between eight and fifteen years of age; only one-fourth prior to eight years.

The incidence of sarcoma for comparison is not given.

**Chondroma.**—Cartilaginous tumors are occasionally observed at the adolescent period, with an origin apparently dependent in some instances on heredity, and in others, on early rachitic changes. The epiphyses afford favorite sites.

**Osteoma.**—Bony growths are not infrequent in the cranial bones, at times arising from the orbit. A congenital origin is to be considered.

**Angioma.**—This neoplasm is exemplified by the various forms of vascular nevi. (See p. 657.) These tumors may arise in embryonal fissures or in proximity to nerve trunks. Traumatic origin has been occasionally remarked.

**Sarcoma.**—Various forms of sarcomata occur in childhood, those of bone being probably the more frequent. In some instances trauma is undoubtedly the exciting cause. Metastases which may involve the lung are to be expected, depending on the exact morphology of the primary growth. This, when possible, should be determined by microscopic examination of an excised section of tissue.

*Illustrative Case.*—A fatal outcome in a case of a rapidly growing bone sarcoma of the scapula in a boy of nine years was postponed, with an apparent period of temporary improvement, through the persistent and intensive use of radium. The disease terminated fatally in a period of approximately two years.

**Lymphoma and Lymphosarcoma.**—Various tumors of lymphoid tissue are well recognized in childhood and are to be differentiated from certain types of Hodgkin's disease exhibiting sarcomatous characteristics (e. g., lymphosarcoma of the thymus), syphilitic and tuberculous adenitis, and the leukemias. Ewing<sup>1</sup> has noted that lymphosarcoma cases may show only a moderate degree of illness until shortly before death, while the cachexia of Hodgkin's disease is apparent over a long period. The structure of an affected gland determined by its excision and examination microscopically affords accurate diagnosis.

**Tumors of the Brain.**—Of these the cerebellar growths appear to be relatively the more frequent in children. Glioma, endothelioma, and sarcoma are the more common types. Glioma of the retina, which may be bilateral, occurs in two-thirds of the cases before the fourth year (Ewing).

**Embryonal Sarcoma of the Kidney.**—This well-recognized malignant growth is rare except in the first few years of life, the majority of cases terminating fatally before the age of three years. The growth is typically of a complex structure described by the term "adenomyosarcoma," and may attain such a size as to fill the entire abdomen.

**Hypernephroma.**—The occasional presence of embryonic adrenal rests in the kidney explains the origin of this growth in which there is a resemblance of structure to that of the adrenal in distinction from that of the kidney.

**Tumors of the Adrenal, Pituitary, and Pineal Glands.**—Reference to this subject has been made in the section on Diseases of the Glandular System (pp. 475-477).

<sup>1</sup> Neoplastic Diseases, 1922, p. 381.

## FOREIGN BODIES

From the fifteenth month to the sixth year is the period of life of humans when their desire for a close association with all sorts of objects is most prominent. This period covers the superinquisitive age. The child must handle things and manipulate every object he can get his hands on in every possible way. After he has satisfied himself in this respect he does not always know how to dispose of the articles. If these are small enough a few prominent and readily accessible openings in his anatomy appeal to him and become the resting places for a vast variety of objects. These selected repositories for foreign bodies are the nose, ears, and mouth.

**Foreign Bodies in the Nose.**—The favored article here is a shoe button, next in order are beads, and then follow kernels of corn, peas, beans, pieces of cork, and of coal, wads of absorbent cotton, and live bugs. We have repeatedly removed articles belonging to the above group from the nostrils and ears of young children.

Country children waddling through the potato patch are particularly attracted by the green potato bug. Two such were recently removed from the nostrils of respective children.

The remains of a dead cockroach were not long since removed from a child's ear.

In some cases the discomfort occasioned by a foreign body will be complained of and the child then comes with the ready-made diagnosis. In other instances, and perhaps more often, the presence of a foreign body in the nose will be suggested by unilateral nasal discharge, more or less profuse, usually purulent, and perhaps blood stained. This usually means one of two conditions, an infection with the Klebs-Löffler bacillus or the presence of a foreign body.

A probe slightly curved readily determines whether a foreign body is present. A culture in cases of doubt settles the question of diphtheria.

If a foreign body is located it is best removed by wrapping the child in a sheet, binding the arms closely to the sides. Held by an attendant, the child then rests on his back with his head between the knees of the physician, with face upward. This procedure permits the best position for removal of the object, either with a small forceps or a probe slightly curved at the distal end. This is passed after the manner of the obstetrician in introducing the first blade of the forceps, along the side of, and then around, the object.

In cases in which the foreign body is firmly wedged an anesthetic will be required. Foreign bodies in the oral cavity are usually readily removed with small thumb forceps. A solution of 5 per cent. bicarbonate of soda is useful for purposes of cleanliness after the removal of a foreign body.

**The Mouth as a Repository.**—When a small object is placed in the mouth it is sometimes coughed out and at other times is swallowed and passes into the stomach. Instead it may be aspirated into the larynx, where it becomes lodged or whence it passes through into the trachea or bronchi.

The accompanying cut (Fig. 145) demonstrates the possible dangers of swallowing foreign objects. A small watch disappeared from the neck of a girl four years of age. Because of the belief that it was swallowed, the stools were examined daily. The

child took the usual diet without inconvenience, and it was assumed that the watch had passed into the stomach. After five days it was decided to locate the watch or at least determine if it was in the child's digestive tract. An x-ray examination located the object as shown. A surprising feature in this case was the passage of the food alongside the watch. Without the x-ray the case would probably have been fatal, through the formation of a perforating ulcer of the esophagus. The patient was placed on her back with the head over the side of a table, to put the mouth and esophagus on

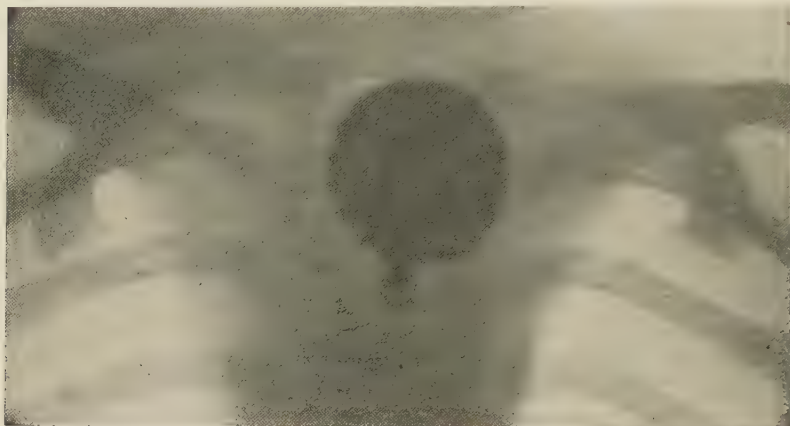


Fig. 145.—Small watch in the esophagus.

a plane. By means of a "penny-catcher" Dr. Robert Abbe, with some difficulty, succeeded in removing the watch.

### Foreign Bodies in the Stomach.—Here again the variety is legion.

*Illustrative Cases.*—Within the past year two children have swallowed and passed open safety-pins.

A baby six months old swallowed an open safety-pin. The mother was not aware of this fact until she found the pin obstructing the anal outlet.

A fifteen-months-old boy swallowed an open safety-pin of medium size during the last week of July. An x-ray of the chest and abdomen failed to reveal the pin. In October the mother brought the pin to the junior author's office with the explanation that it had only then been passed from the bowel. Investigation disclosed that the x-ray had been taken so as to reveal nothing above the suprasternal fossa and that on the occasion of the examination, the pin was probably lodged at the level of the cricoid cartilage, a favorite site for such obstruction.

At the time of this writing a child is under observation who has had in his stomach an open pin, revealed by the x-ray, for the period of four weeks.

We have had children who fed on their own hair and such articles as woolen blankets. In such instances the foreign material is usually passed in balls.

It is surprising what large and apparently dangerous objects will pass through the entire gastro-intestinal tract without harm. The danger lies in the object becoming fastened in some portion of the intestine and thereby producing ulceration and perforation.

Active laxatives should not be employed in treating children who have swallowed foreign bodies. Milk, bread-stuffs, and cereal foods that will make a large fecal mass should be given with the hope of carrying along the object.

The x-ray should be used, repeatedly if necessary, in all cases in which there is a delay in the expulsion.

**Foreign Bodies in the Air-passages.**—Foreign bodies are usually lodged

in the larynx by an act of sudden inspiration attended by a quick, forward movement of the head, as in coughing or laughing with the object in the mouth or between the teeth.

It is customary to describe the invasion of a foreign body into the larynx as accompanied by strangulation, coughing, and choking of a severe character. This has been disputed by Chevalier Jackson who emphasizes the point that while such symptoms may be present there are a very considerable number of cases in which no laryngeal symptoms are noticed at any time, the foreign bodies passing through the larynx so quickly as to cause no irritation.

Jackson has recited the case of a girl eleven years old in whom a piece of rabbit bone 14 x 21 mm. was lodged in the larynx for eighteen months without producing sufficient reaction to completely cut off the air-supply.

Inversion of the patient has been of no service whatever in our experience. The first procedure is to introduce into the mouth the index-finger, with the hope that a portion of the mass may protrude sufficiently to make possible its removal. Should the attempt fail, a laryngeal forceps should be brought into use, its introduction being guided and guarded by the index-finger. When this is not successful, tracheotomy may be required to relieve the child from immediate danger of suffocation, after which further surgical procedures may be considered.

Sudden and paroxysmal cough, dyspnea, cyanosis, and hemoptysis have all been explained by the presence of foreign bodies in the bronchi. Bronchopneumonia and pulmonary tuberculosis have been the conditions early diagnosed in repeated cases of lung involvement later proved to be due to the presence in the bronchi of foreign bodies, many of which had been retained for months and years.

The x-ray should be employed upon all manifestations of abnormal conditions within the respiratory tract.

For a detailed and authentic study of this subject the reader is referred to Jackson's contribution.<sup>1</sup>

<sup>1</sup> Amer. Jour. Med. Sci., May, 1921.

### XXIII. SPECIAL DIAGNOSTIC METHODS

So manifold are the special tests now available for completing and confirming ordinary physical diagnosis that more than a cursory survey of the special methods is here impracticable. Among the materials commonly sent to the laboratory for examination are blood, urine, stools, breast milk, gastric contents, sputum, cerebrospinal fluid, various exudates and transudates, conjunctival and vaginal discharges, and cultures from the throat.

**Blood** must be obtained in many cases not only for the routine cell count, but for culture, Widal test, the Wassermann test, and detailed blood chemistry study. It is essential that the physician be at all times prepared to obtain promptly any specimen indicated in a given case. For example, *Streptococcus viridans* growth may be apparent in a blood-culture only after the lapse of several days or even a week, so that the time element is readily seen to be of great importance in prompt diagnosis.

**Urine** may be obtained from young infants by means of the Spicer urinal, the Chapin urinal, or one of the many test-tube devices kept applied to the urethral orifice. Catheterization is seldom essential in obtaining urine for ordinary culture, provided aseptic precautions are observed in collecting the specimen. Catheterization of the female ureters may be satisfactorily done at an early age by one who is skilled in the technic.

**Sputum**, even in the presence of a productive cough, is not readily obtained from young children because of their failure and apparent incapacity to expectorate. The insertion of a catheter into the throat will often induce coughing of sufficient degree to lodge upon the catheter material suitable for microscopic study.

The **ophthalmoscope** is available not only for routine eye tests but for detection of nephritis, amaurotic idiocy, and intracranial lesions including tuberculous meningitis and brain tumor.

The **laryngoscope** and **bronchoscope** are invaluable in the recognition of various forms of respiratory obstruction and in revealing localized ulcerations. These instruments have been employed with most gratifying success in the removal of foreign bodies from the air-passages. The **esophagoscope** has a similar range of application.

**Fluoroscopy** is of signal value in the study of the chest and abdomen. This means of confirming the findings of ordinary physical examination is extremely satisfactory, and its range of applicability includes the observation of the gastric and intestinal activity and the recognition of abnormalities, among which should not be forgotten diaphragmatic hernia.

The **x-ray** is available for countless purposes, ranging from the study of pathologic changes within the thorax to the study of rachitic bones and the localization of foreign bodies in the respiratory tract or the alimentary tract.

**Study of the electric reactions** is of value, not only in estimating the significance and degree of various paralyses but also in the recognition

of latent tetany and in the diagnosis of obscure and unusual neurologic disorders, *e. g.*, amyotonia congenita.

**Gastric analysis**, although less relied upon than formerly, is of value to the pediatricist, provided minor variations in chemistry are disregarded. Incidentally the permeability of the esophagus is readily ascertained on passing the stomach-tube.

**Duodenal catheterization** employed for aspiration of duodenal contents is similarly of definite aid in determining the permeability of the pylorus.

**Pleural Puncture (Thoracentesis).**—The point of election for this procedure which is often demanded by the diagnosis of a fluid effusion in the pleural cavity is the seventh or eighth intercostal space in the mid-axillary line.

The patient lies on the unaffected side with the shoulders elevated by pillows, and the arm on the affected side drawn forward and upward. The aspirating needle, which should be of good strength and caliber, should be introduced in the interspace just above the costal border, with a sharp thrust, to a depth of an inch or more, when it may be detected that the point of the needle is in a free cavity. Aspiration should be performed very gradually and stopped on the occurrence of coughing.

**Pericardial Puncture.**—This may be urgently required in the presence of traumatic hemopericardium and pericarditis with effusion, not only to corroborate diagnosis but as a life-saving measure.

The puncture should be made at the site of a small preliminary incision, with a needle or fine cannula and trocar fitted to an aspirating apparatus. The point of election is in the fifth intercostal space close to the left sternal border. From this point the needle should be directed obliquely downward and inward. By Dieulafoy's method the puncture is made in the fifth space 4 fingerbreadths from the sternum through a short vertical preliminary incision. The needle is cautiously pushed obliquely inward from this point almost parallel to the plane of the chest wall.

**Peritoneal Puncture.**—This procedure is of comparatively recent development and should never be employed indiscriminately. The needle may be inserted as in making an intraperitoneal injection at a point about 2 inches below the umbilicus. (See p. 850.) The needle should be directed carefully inward and upward until it enters the peritoneal cavity.

The indications for exploratory puncture of the pleural, pericardial, peritoneal, and joint cavities are generally appreciated. As a fixed principle, one should refrain from any purely diagnostic step involving the introduction of a needle into a cavity normally sterile, until all ordinary means of arriving at accurate recognition of the existing diseased condition have been exhausted.

**Lumbar Puncture.**—The site selected for lumbar puncture is on a line between the crests of the ilia and between the spinous processes of the third and fourth lumbar vertebræ.

**Position of the Patient.**—The child should rest on one side (Fig. 147), sufficient pressure being exerted on the buttocks to make the spinous processes prominent. The Quincke needle (Fig. 146) should always be used in making the puncture. The stylet which fits the beveled edge of the point of the needle effectually prevents its being plugged.

**Method.**—The skin for several inches about the site of the puncture

should be scrubbed with tincture of green soap and alcohol. The physician's hands should be thoroughly disinfected. Considerable force may be necessary in order to enter the canal. When there is a sudden giving way of the obstruction to the progress of the needle, one may know that the canal has been entered. The puncture may be made in a line with the spinous processes or from the side, the needle being passed between the laminae and inward about 1 inch. When the point of the needle has been introduced into the spinal canal, the stylet is with-



Fig. 146.—Quincke's needle.

drawn. The cerebrospinal fluid may escape with force in a stream as a result of the pressure or it may exude drop by drop. A sterile tube should be in readiness in order to collect the fluid for examination. In dealing with older children after the third year it is often easier to introduce the needle slightly to the right or left of the line of the spinous processes.

When the canal is entered and the cerebrospinal fluid does not pass readily through the needle, the flow may be increased by elevating the child almost into a sitting position with the head forward. A dry tap



Fig. 147.—Position for and site of lumbar puncture.

usually means that the canal has not been entered. For some children it will be necessary to employ a slight degree of anesthesia. Gas or chloroform may be employed for this purpose.

*Uses.*—The uses of lumbar puncture are threefold: for diagnostic purposes, as a means of conveyance of sera to the spinal canal, and for the relief of acute pressure symptoms by the withdrawal of the fluid.

**Ventricular puncture** should be performed only in the event of apparent blocking of the cerebrospinal fluid channel at the base of the brain (as determined by examination including previous lumbar puncture), and is

applicable only exceptionally after the age when closure of the anterior fontanel is completed. The head should be shaved and aseptically cleansed. With the patient in the recumbent position the needle is inserted through the anterior fontanel a little less than 1 cm. to one side of the midline and is directed forward and slightly downward to a depth of not over  $1\frac{1}{2}$  inches.

The introduction of air or phenolphthalein into the ventricle is occasionally resorted to in the differentiation of the exact character of a hydrocephalus.

**Cisterna puncture** is occasionally employed, when the spinal and ventricular taps are found impracticable, for the withdrawal of fluid or the injection of serum. The needle is introduced for about 4 cm. in the midline just above the spine of the axis on a plane traversing the glabella and the upper margin of the external auditory meatus.

**The Widal Reaction for Typhoid Fever.**—To make Widal tests it is necessary to keep in stock a well-agglutinating strain of typhoid bacillus. A bouillon or agar culture which has grown not longer than eighteen to twenty hours should be used for the reaction. The blood to be tested should be obtained in a small glass tube of the Wright pattern, 0.5 to 1 c.c. in amount, sealed at both ends, and the serum allowed to separate. Sterile physiologic salt solution is used as the diluent. A porcelain palet with six or more cup-like depressions is a convenient receptacle for holding the dilutions, if the microscopic method is used.

By means of a capillary tube marked by a wax pencil 1 drop of serum and 9 drops of salt solution are mixed in one of the palet cups, making a dilution of 1 : 10. From this stock other dilutions are made; 1 drop to 4 of salt solution equals a dilution of 1 : 50, etc. The addition of 1 drop of culture to 1 drop of a 1 : 10 dilution of serum makes a dilution of 1 : 20. This is examined on a hollow slide with a No. 7 lens. Controls of the culture alone, and of culture plus normal serum should be made at the same time. Cessation of motion and clumping of the bacilli within one-half to one hour, in a dilution of 1 : 40, constitutes definite proof of typhoid infection.

The microscopic method should be employed by preference.

By the macroscopic method dilutions are made in small test-tubes. The tubes are placed in the incubator at  $37.5^{\circ}\text{C}.$  for one hour and then in the ice-chest overnight. The reaction can be read at a glance. The clumped bacilli fall to the bottom of the tube and leave the serum quite clear, while the control remains turbid and smooth. The quantity of serum required is very small, 0.2 cm. being sufficient to make all necessary dilutions. Each tube may contain 0.8 cm. of diluted serum and 0.2 cm. of bacillary suspension, making a total of 1 cm. Agglutination in a dilution of 1 : 40 may be looked upon as a positive reaction.

With blood dried on a slide the test cannot be accurately made. Cultures of typhoid bacilli killed with formalin have been used for making the Widal test, but the method has nothing to recommend it.

The Widal reaction does not give positive results before the end of the first week or the beginning of the second week of typhoid. It may continue to be positive throughout convalescence and for an indefinite period thereafter. Occasionally its appearance is deferred until conva-

lescence or until a relapse comes on, but it is present at some time during an attack of typhoid fever in over 95 per cent. of all cases.

**Tests for Tuberculosis.**—*Tuberculin* is used as a diagnostic agent to detect early, latent, or doubtful cases of tuberculosis. Different methods have been employed in the application of tuberculin.

*Subcutaneous Inoculation.*—The dose used for diagnosis is larger than that allowable for immunization purposes, from 1/10 to 5 or 10 milligrams being used, according to the age of the child. If the patient is tuberculous, the injection is followed in eight to twenty-four hours by a rise of temperature, a certain amount of malaise, tenderness at the site of injection, and râles over the suspected lung area. The reaction is general as well as local. The temperature falls within twenty-four hours. No reaction occurs in non-tuberculous cases, while in 95 per cent. of those of tuberculosis the test is followed by a positive reaction. Absolute exclusion of tuberculosis, however, because of a negative result, is not possible. The test is applicable only to cases which do not run a temperature over 37.7° C. (100° F.), and is useful in doubtful and obscure cases. It may be necessary to repeat the inoculations two or three times before a positive reaction occurs; the initial small dose of 1/10 milligram being followed in three days by another of 1 milligram, and again, if necessary, in three days by another of 3 or 5 milligrams in older children.

A second subcutaneous test is the puncture or stick reaction of Hamburger. In older children 1/1000 to 1/100 milligram of tuberculin is injected just beneath the skin. Within twenty-four hours the local reaction begins and lasts for five or six days. The redness and induration are visible at the point entered by the needle, and also at the place where the injected fluid is deposited.

*Cutaneous Inoculation.*—This method of vaccination with tuberculin was introduced by von Pirquet. A small superficial scarification is made on the forearm, and a drop of undiluted tuberculin is applied. An untreated scarified area of equal size is made at the same time for control purposes. In cases of active tuberculosis the reaction begins within twenty-four hours. A small red papule forms, surrounded by a limited area of redness and induration. In four to eight days the nodule has disappeared. The control scarification heals without any inflammatory sign. Von Pirquet himself uses a fine boring instrument instead of scarifying. The method is most valuable in infants and children under two years of age. A positive reaction is accepted by von Pirquet as proof positive of tuberculosis. A negative reaction, on the whole, means absence of any tuberculous focus.

In the last days of a miliary tuberculosis the reaction fails to appear in about half the cases. Furthermore, in cachectic conditions from any cause the reaction does not appear. During the eruptive stage of measles it is absent in 100 per cent. of tuberculous cases, while in scarlet fever the negative result is less constant, the reaction failing to appear in 85 per cent. of the cases. After the eruption has disappeared a von Pirquet reaction may be obtained. Tuberculous patients suffering from diphtheria or typhoid fever also fail in some instances to react to the cutaneous tuberculin test.

*Differential Cutaneous Reaction.*—Detrè devised this method of diagnosing human from bovine tuberculous infection. He used the filtrates of bouillon cultures of human and bovine tubercle bacilli, applying them by the von Pirquet cutaneous method, making the scarifications and the applied drop of fluid as nearly alike as possible. The diagnosis is determined by the relative size of the resulting reaction papules, which Detrè carefully measures. Thus far, most observers find that in the majority of cases the two reactions are equally marked, and it has not yet been established that the differential diagnosis between human and bovine tubercle bacillus infection is possible by this means.

*The Moro Inunction Test.*—Equal parts of old tuberculin and anhydrous lanolin are used in the form of a salve. The dose is about 1 gram of the ointment, rubbed into an area of healthy skin about 5 cm. in diameter. The application is made in the epigastric or submammary region, a rubber finger-cot or glove being used to rub the ointment into the skin for three-fourths of a minute or more. The inoculated area is exposed to the air for ten to twenty minutes, and no dressing is applied. It is well to clean the site of the inunction with alcohol before applying the salve, and also to ring the inoculated area. A control with plain lanolin is to be made on another part of the skin. The reaction manifests itself in ten to seventy-two hours, but in the majority of cases it does not appear later than the second day. The eruption which appears is papulovesicular in character, with an erythematous areola around the individual papules. In a severe reaction the areolæ may coalesce. The papules vary in number from very few (1 to 4) to very many (50 to 100). Itching sometimes occurs. The eruption persists for several days; in severe cases it may be apparent for seven to ten days, and may be followed by pigmentation and desquamation. The test is simple and harmless. As a rule, the von Pirquet reaction is fully developed several hours before the inunction (Moro) reaction.

*Ophthalmic-reaction.*—This was first described by Wolff-Eisner and shortly afterward by Calmette. It consists in the instillation of 1 drop of 0.5 per cent. solution of tuberculin into the conjunctival sac of the healthy eye of the patient. Within twelve hours swelling and redness are at their height, and gradually subside in twelve hours more.

The advantage of the cutaneous method over the subcutaneous is that the former obviates the possibility of spreading the tuberculosis, since no general reaction follows the application. Both methods are based upon the principle that in the course of a tuberculous infection all the cells of the body are sensitized to the products of the tubercle bacillus. When, therefore, a minute quantity of such products (tuberculin) is brought into direct contact with a sensitized and vascular tissue, like the skin or conjunctiva, a rapid inflammatory response occurs.

*The Mantoux or Intradermal Test.*—For routine use this test is the most reliable of all. The reasons for choosing this method, with a description of the technic have been given in a review by Smith.<sup>1</sup>

“The subcutaneous general febrile reaction is not in general use, and is somewhat dangerous in childhood; the Calmette and Moro have been

<sup>1</sup> Charles Hendee Smith, Tuberculosis in Childhood, Bulletin of New York Tuberculosis Association, 1923.

practically abandoned. Those in common use are the Pirquet or epidermal, and the Mantoux or intradermal reactions.

"We have found at Bellevue Hospital that the intradermal is at least twice as accurate as the Pirquet, and has the single disadvantage that the dilute solution must be prepared. It is very simple, however, to prepare.

"For a 1:1000 dilution, put 1/10 c.c. of old tuberculin in 100 c.c. of salt solution. (This can be rapidly done by any one with boiled water and a salt tablet.) Dose: 1/20 c.c. or 1/20 mg. for infants (0.00005 gm.) and 1/10 c.c. or 1/10 mg. for older children (0.0001 gm.).

"These amounts are injected into the skin not under it (just as in the Schick test). If negative, in suspicious cases a larger dose may be used, up to 4/10 or 6/10 mg., taking care not to increase too rapidly in order to avoid a general reaction. The reaction is easy to read, safe and accurate, and if positive gives a much larger erythema than the Pirquet. It should be read daily for five days, or if only once, on the second or third day.

"The Pirquet is slightly easier to do, but gives us only about half as many positive reactions, due to unavoidable sources of error intrinsic to the reaction, even when done with the greatest care."

The study of a large series of cases with the aid of the intradermal test at Bellevue has shown that not over 40 per cent. of children there examined are infected at puberty. This percentage is lower than that for any previous series reported in this country. (See Fig. 135, p. 767.)

**The Schick Test for Susceptibility to Diphtheria.**—This reaction and its range of application have been previously discussed (pp. 688-690).

**The Dick test for susceptibility to scarlet fever** has also received mention (p. 704).

**The Wassermann Test for Syphilis.**—The Wassermann reaction is the application of the complement fixation or deviation test to the diagnosis of syphilis. As introduced by Wassermann, Neisser, and Bruck it required the use of guinea-pig complement, the serum to be tested, antigen consisting of extract of syphilitic liver, and a sheep's hemolytic system. By sheep hemolytic system is meant an immune rabbit serum prepared by inoculating rabbits with washed sheep's erythrocytes, and a suspension of washed red blood-cells of the sheep. In the presence of fresh guinea-pig serum (complement) such an immune serum has the power of hemolyzing the red blood-cells. In the same way human hemolytic system means the combination of washed human erythrocytes and an immune serum prepared by inoculating rabbits with washed red blood-cells of the human type.

If the serum to be tested contains immune bodies specific to the antigen used, these will, in the presence of complement, unite with each other and bind the complement. The addition of the hemolytic system will then cause no change in the tubes, *i. e.*, hemolysis will not occur. If the antigen and the immune serum are not specific, then the complement is left free to unite with the hemolytic system and hemolysis occurs. This is called the *complement fixation or deviation test*.

As simplified by Noguchi, the test requires much smaller quantities of guinea-pig complement, the serum to be tested, antigen consisting of human or animal tissue extract, and human hemolytic system. For

practical purposes 1 c.c. of the patient's blood will give an ample amount of serum for the test.

The Wassermann seroreaction is positive in 98 per cent. of cases of congenital syphilis, but only in 66 per cent. of latent syphilis. During the primary stage of acquired syphilis 90 per cent. of the cases give a positive Wassermann test, during the secondary stage, 96 per cent.; and during the tertiary stage, 83 per cent. react positively.

Craig has found that the reaction may disappear from two to four weeks after the institution of mercurial treatment, but it may return when the treatment is stopped; therefore it is not established that the disappearance of the reaction justifies the conclusion that the disease has been cured, and that treatment may be discontinued.

Noguchi found that after treatment with salvarsan the reaction may disappear within two weeks in promptly cured cases, although it may not do so for four or five weeks.

The **spinal fluid Wassermann reaction** is employed in the diagnosis of neurosyphilis. This test may be positive in the presence of juvenile tabes or paresis even when the blood Wassermann reaction in the patient is negative.

**The Noguchi Butyric Acid Test.**—This test is based upon the fact that the globulin reaction in the blood-serum and in the cerebrospinal fluid is increased in syphilis. In the case of the blood-serum the test is too complicated to be used anywhere except in a highly equipped laboratory and, moreover, it is not needed in children, since Wassermann's serum reaction answers all practical purposes. Applied to the cerebrospinal fluid, the Noguchi test is very simple and is carried out as follows: 1/10 or 2/10 c.c. of cerebrospinal fluid, which must be absolutely free from blood, is mixed with 1/2 c.c. of a 10 per cent. solution of butyric acid in normal saline and boiled. Then 1/10 c.c. of normal sodium hydroxid solution is quickly added, and the whole is boiled for a few seconds. A granular or floccular precipitate indicates a positive reaction. The appearance of the precipitate within a few minutes indicates a considerable increase in globulin, while weaker reactions may not appear for an hour. Two hours should be the time limit.

Normal cerebrospinal fluid with this test gives a slight opalescence and occasionally turbidity, but the granular precipitate does not occur at all or only after the time limit has been reached.

A positive reaction occurs with the cerebrospinal fluid from any case of syphilitic or parasyphilitic affection, and also in all acute inflammations of the meninges, whether due to the meningococcus, the tubercle bacillus, the pneumococcus, the streptococcus, or the influenza bacillus. The reaction is also positive in the early stage of poliomyelitis. Such conditions can, of course, be readily differentiated from syphilis. In acute luetic meningitis the presence of *Treponema pallidum* in the cerebrospinal fluid will serve to exclude the other forms of meningitis. Such a case has been reported by Rach<sup>1</sup> in a child four months old. In hydrocephalus the cerebrospinal fluid gives a positive butyric acid test in cases which are of syphilitic origin. When the amount of cerebrospinal fluid is increased without inflammation of the meninges, as sometimes

<sup>1</sup> *Jahrb. f. Kinderh.*, 1912.

happens in pneumonia, the fluid does not give a positive butyric acid test.

In children Noguchi's test is most valuable in differentiating between inflammatory and non-inflammatory conditions of the meninges.

**The Colloidal Gold Reaction of Lange.**—This depends on the fact that normal cerebrospinal fluid when diluted with a 0.4 per cent. sodium chlorid solution does not produce color change in colloidal gold, while pathologic cerebrospinal fluid similarly treated produces distinctive changes for various diseases. This reaction is specific for syphilis of the nervous system and is applicable to the diagnosis of meningitis. By means of observations on the quality of the color change produced under different dilutions of the spinal fluid typical curves are plotted significant in diagnosis of the various diseases.

**Tests for Renal Function.**—In addition to the routine urinary examinations customary in the general practitioner's office various tests are invaluable for the purpose of more accurate differentiation and prognosis in cases of disease of the kidney. In an estimate of the value of kidney function tests Longcope<sup>1</sup> has designated the phthalein excretion and blood chemistry findings as of value in making the prognosis in acute nephritis. In chronic nephritis the chlorid and nitrogen concentration particularly, together with the phthalein excretion, afford information of value. Blood chemistry offers a means of differentiating uremia from other kinds of coma.

The *phenolsulphonephthalein test* devised by Rowntree and Geraghty<sup>2</sup> consists in the determination of the rate of excretion by the kidney of 1 c.c. of a solution containing 0.6 gram of phenolsulphonephthalein injected in the upper arm. By the normal kidney 40 to 60 per cent. of the drug is excreted in the first hour and 20 to 25 per cent. in the second hour, this excretion occurring without conformity to the rate of excretion of water.

The phthalein test is most reliable in acute conditions. Two factors markedly influencing this test are the rate of absorption of the dye, depending on the size of the injection and the existence or non-existence of edema; and the amount of urine in the bladder, which should, of course, be empty at the time of the injection.

The *Mosenthal test*,<sup>3</sup> based on a modification of a test for estimating renal function, proposed by Hedinger and Schlager<sup>4</sup> has been simplified so that it is at present readily available in ordinary practice. With a normal diet in health the maximum specific gravity of the urine is to be regarded as 1018 or 1020 or higher, and a variation of 9 degrees between high and low specific gravity should obtain. The volume of the night urine representing the total voiding from 8 P. M. to 8 A. M., in children (depending on the age) should be 200 to 500 c.c., the total twenty-four-hour excretion being about 1 liter. The nitrogen and sodium chlorid normally constitute about 1 per cent.

When renal function is impaired the quantity of night urine becomes increased and the specific gravity of the urine shows fixation which may

<sup>1</sup> Boston Med. Surg. Jour., 189, 269, 302, August 23, 1923.

<sup>2</sup> Jour. Phar. Exper. Therap., 1910, i, 579; Arch. Int. Med., 1912, ix, 284.

<sup>3</sup> Arch. Int. Med., 1918, xxii, 770.

<sup>4</sup> Deutsch. Arch. f. klin. Med., 1914, cxiv, 120.

be at a high or low level, while the salt and nitrogen elimination is diminished. Variations in degree of edema elimination are to be considered in interpreting the test, but the interpretation is not dependent, as was at first thought, upon special diet.

In applying this method the urine is collected at two-hour intervals in separate containers from 8 A. M. to 8 P. M. That voided from 8 P. M. to 8 A. M., constituting the total night urine, is collected in one container.

*Estimations of urea and urinary nitrogenous constituents of the urine*, formerly much in vogue, are of little value unless combined with a study of the food intake and the chemical content of the blood. Such tests are therefore impracticable.

**Blood chemistry determinations** are not needed for the recognition of the existing kidney disease, but within limits are more reliable than urinary and functional tests and afford information on the following points: (1) Whether nitrogen or salt and water elimination is defective, (2) degree of retention, (3) prognosis, and (4) trend of the disease, particularly in response to treatment. In various acute infections, postoperative states, diarrhea, vesical calculus, and pyelitis a determination of the non-protein nitrogen and its constituents will show the degree of impairment of kidney function and afford warning of impending nephritis.

The following figures may be taken as normal for the more important substances routinely determined in blood chemistry study:

	Milligrams per 100 c.c.
Non-protein nitrogen.....	20- 30
Urea nitrogen.....	8- 15
Uric acid.....	1- 3
Creatinin.....	1- 2
Glucose.....	60-120
Chlorids.....	550-600
Calcium.....	9- 12
Phosphorus.....	5- 6
Cholesterol.....	150
Corpuscular volume.....	35- 45 per cent.
Carbon dioxid combining power.....	45- 65 volumes per cent.

Of the non-protein nitrogen constituents *creatinin*, because it is ordinarily eliminated most readily by the kidney, serves as a valuable prognostic indicator of the kidney capacity, creatinin retention occurring practically only in nephritis. A creatinin content of over 3 mgm. is considered serious and one of over 5 mgm., of fatal prognostic import.<sup>1</sup>

*Uric acid* is most difficult to eliminate and in acute conditions is the first constituent to show an increase. In chronic conditions there is no greater difficulty in its elimination than in that of creatinin and non-protein nitrogen.

Estimation of the *carbon dioxid combining power* of the blood, for which the Van Slyke method is replacing the alveolar air determination method, affords valuable information respecting the degree of acidosis in diabetes, intestinal intoxication, and postoperative disturbances of metabolism. The administration of insulin in diabetes should be checked by repeated blood chemistry observations of this type as well as by frequent estimations of blood-sugar and urinary sugar.

<sup>1</sup>It should be noted that what is determined as creatinin may actually not be creatinin, but the significance of the color-producing substance remains the same.

The determination of the *calcium* and *phosphorus* content of the blood is particularly valuable in rickets and spasmophilia, although careful clinical examination will reveal rickets before it is disclosed by *x-ray* or blood analysis. When the *x-ray* shows the disease there is regularly a diminution in the phosphorus content of the blood. In active tetany the blood calcium is always low, without significant increase in the phosphorus content. In rickets complicated by tetany, however, the phosphorus is relatively high as compared with that in uncomplicated rickets. Latent tetany may be shown by low blood calcium as well as by the altered electric reactions.

**Other tests** to be kept in mind as of particular importance practically are *the hemolysis and agglutination tests* to determine compatibility of donor's and recipient's blood for transfusion, *the blood fragility test*, invaluable in the diagnosis of hemolytic icterus, and *the estimation of coagulation time and bleeding time*.

## XXIV. THERAPEUTIC MEASURES

### THE FUNDAMENTALS OF THERAPEUTICS IN CHILDHOOD

It has been our object, in this work, to present as clear and detailed a description of the management of the illnesses of infancy and childhood as space would permit, with a view to a better understanding of pediatric therapeutics.

If asked what should be considered an important requisite for the successful practice of pediatrics, we would answer: The education of the mother. It is impossible to do even fairly good work in treating diseases of children without proper home co-operation. A direction is never followed out as well as when the reason for it is properly understood.

Many of our beneficial results are due to the therapeutic influences of remedies outside of the realm of drugs. Thus, diet, fresh air, sunshine, cold, heat, massage, electricity, climate—all are important therapeutic agents in the diseases of children. Successful therapy applied to children requires an understanding and a knowledge of detail greater, perhaps, than for any other line of medical work. It not infrequently is an absence of such knowledge on the part of medical men, which explains a great deal of the therapeutic doubt existing at the present time. Therapeutic nihilism, so far as pediatrics is concerned, means ignorance and incompetency. The time when the physician can make a diagnosis and cease from interest in the treatment of the case is past. The faith of humanity in curative agents is remarkable, and when the desired end is not reached by the first physician, some other physician is called; and when he fails, the next resort usually is the charlatan or the proprietary medicine.

The prosperity of the irregular schools of various cults and "sciences" supposedly healing in character, and the consumption by the people of millions of dollars' worth of useless patent drugs, are to be attributed in a large degree to an indifferent application of therapeutic measures on the part of otherwise well-qualified medical men. A few great teachers of medicine, by precept and example, have done an incalculable amount of harm in their attitude toward therapeutics. Because they were, or are, unable successfully to treat disease, they assume that it cannot be done. Thus, therapeutic doubt has been in the past boasted of by men considered clever. Text-books on pediatrics are not without fault in encouraging careless practice, with necessarily an absence of favorable results, especially when they state that "treatment is along supportive lines." What constitute "supportive lines" in a given case? How is the practitioner to know the author's mind? Or, again, perhaps it is stated that "free stimulation" is necessary. Stimulation how, when, why, and by what means is what must be known, in order to achieve satisfactory results. "Treatment according to the indications of the case" does not help a puzzled physician to any great extent. "Treatment along the same lines as in adults" adds no illumination when a desperately sick child is the patient, and moreover is faulty teaching, for the reason that

an infant or young child should never be treated the same as an adult, either by drugs, or other means, unless we wish more thoroughly to convince ourselves of the uselessness of therapeutic measures.

In order to practice therapeutics successfully with children the methods of the physician must be flexible and adaptable. Children vary in their physical and mental equipment much more than do adults. The practice of pediatrics is necessarily difficult, for every case has to be studied from its own standpoint. The physician who invariably treats all his cases alike will never do the highest class of work with children. The man, for example, who feeds all his difficult feeding cases after one rule or pattern will be sure to have some other practitioner get his failures, which will not be few. A source of disappointment to the physician, particularly in the treatment of young infants and children, exists in the disorders of nutrition. A tremendous amount of patience is required in dealing with such cases, and the absence of prompt results is one of the difficult features he has to contend with in his relations with the family. There is, further, a distinction to be made as to what constitute good results. If the infant develops into a strong child, we may chronicle our results as satisfactory even though a year elapses before the condition of the patient becomes satisfactory. To cause a malnutrition baby weighing only 8 pounds at six months, with marked milk incapacity, to show rapid growth by any method of artificial feeding is unusual, and results are good if he gains but little during the first few weeks. Chronic colitis, tardy malnutrition, or nephritis may require months and years for correcting and yet permit of satisfactory results.

In the treatment of infants and children, particularly as regards the use of drugs, two points are to be kept in mind—the benefit hoped for and the possible harm that may result. A great deal of judgment must be used in the selection of remedies and the means of using them, lest our best intentions result disadvantageously to the patient. Thus, in bronchitis and in bronchopneumonia, the ammonium salts are often given in combination with heavy syrups, such as tolu and wild cherry, both possessing little or no value as expectorants, but having the property of interfering seriously with the patient's digestion. Doubtless, alcohol used indiscriminately is, on the whole, productive of more harm than benefit, largely through disturbing the digestion. Digitalis, the salicylates, and the potassium and sodium salts are all to be used with judgment as to method and time of administration or they will do more harm than good. A point never to be lost sight of in the treatment of diseases of children is the desirability of keeping the gastro-enteric tract in the best possible condition.

In the care of children there are other factors also that bear upon the case that tend toward good or evil. The most careful diet, and the best selected medication are of little value if the patient is overclad, or kept in a superheated room with anxious, distracted, nervously exhausted persons in constant attendance, with the disturbance to the patient which such attendance entails. It must be remembered that absence of proper detail and good judgment, with resulting failures, is no argument against the value of therapeutic measures.

Much may be accomplished by means of prophylaxis in lowering the

mortality in children under five years of age. In this the educated mother's aid is invaluable. She will lay aside prejudices and unfavorable family influences when a physician's direction appeals to her reason. Marasmus, malnutrition, and the intestinal diseases of summer, which directly or indirectly are the cause of thousands of deaths yearly, are to a large degree preventable if the right step is taken at the right time, through the early appreciation of danger signals, on the part of both the physician and the mother.

### THE THERAPEUTIC VALUE OF CLIMATE

That climate is a valuable therapeutic agency in the treatment of diseases of children is a well-recognized fact. An important advantage of a change of climate is that it means more air and probably better air. When patients go to a resort for climatic benefit it is usually at no inconsiderable expense, and they are therefore pretty likely to avail themselves of advantages. The same amount of air could be furnished at home if the family co-operation always could be secured. By the use of the window-board, the roof-garden, and the indoor airing we can to a considerable degree make a climate of our own. Nevertheless, in the majority of families the open-air treatment cannot be carried out successfully; therefore, the best interests of the patients are secured when they are sent away from home. There are conditions also in which such means as those just mentioned do not apply even if they are appreciated. We can give children warm air, and regulate the temperature of the air in the winter; but if they live in any of our coast towns or villages, we cannot give them cool, dry air in summer. Children who can be removed from a large city to the country, inland, for the summer, are invariably benefited, not only as regards their food capacity and the ordinary apparent effects of open-air life, but they acquire also greater powers of resistance, and are thus less liable to acute intestinal diseases. (See Summer Resorts, p. 834.)

**Pneumonia, Pertussis, and Grip.**—During the colder months New York City children who are convalescing from pneumonia, pertussis, or any prolonged illness which has greatly reduced them, will make a much more rapid recovery when removed to Lakewood or Atlantic City, where open-air life is more easily secured than at home.

**Malnutrition and Digestion Disorders.**—Infants and children suffering from chronic digestive disorders, marasmus, and malnutrition, who are given the advantages of climate or open-air methods, either in the home (p. 838) or by a change of residence, invariably make a more rapid recovery than do those deprived of good air because of a lack of appreciation of its value, or through fear of the child's taking cold.

**Nephritis.**—There are diseases in children in which sudden change of temperature, affecting the peripheral circulation, may be decidedly harmful. Such variations are a menace in slow convalescence from acute nephritis, and also in chronic nephritis. Cases of this type require an equable climate, with a permissible outdoor life, such as is furnished during our colder months by Florida and Lower California.

**Asthma.**—Experiences as to the effects of climate in asthma have been contradictory.

With our knowledge of the dependency of asthma upon protein sensitization, the effect of climate on this condition has been relegated to a very unimportant position. Site more than climate is a determining factor in those cases due to pollen sensitization. Centers long reputed of value in hay-fever and asthma we now know achieved their fame due to the absence of plants to which individuals were sensitized.

For the so-called non-sensitized cases which follow or are dependent upon bronchitis a dry atmosphere with relatively slight humidity is of advantage.

**Tuberculosis.**—The best winter climate for a child with pulmonary tuberculosis is a dry climate with a mild temperature, neither high nor low, but with sunshine in such abundance as to permit a daily outdoor life. Such a climate is found in southern New Mexico and Arizona. These places furnish conditions as near to the ideal as it is possible to approach. The Adirondacks, while furnishing a climate in winter which may be too severe for young children, serve well for those from eight to nine years of age in whom the disease is not far advanced.

The *sanitarium treatment* is always to be advised if the patient can afford it, or if it is otherwise available through charity. The advantages consist in the discipline, the diet, the amount of exercise, the sleeping quarters, the clothing—in short, in all the details of the life, every one of which is important. In a sanitarium all these matters are in the hands of those who are skilled in the management of the disease, and who direct each case according to individual needs. Ordinary resorts for tuberculous cases are dangerous because of the possibilities of reinfection through the carelessness of others. In a well-managed sanitarium, however, regulations, regarding expectoration and the care of the sputum reduce this danger to a minimum. Sanitariums, however, are available to but few patients. Many have not the means necessary for change of residence, and many others refuse to allow their children to be separated from them, both of which facts necessitate the home treatment of a great majority of the cases of pulmonary tuberculosis in young children in our larger cities. (See p. 398.)

### SUMMER RESORTS

Where to take a baby for the hot months of the year is a vexed question which is raised in many city households every year, including a situation in which the physician may be called upon for advice.

Several years' observation of a great many New York City children who have spent the summer out of town has led to the following conclusions:

The most desirable summer outing consists in spending the first half of the season at the seashore, the remainder inland, preferably in the mountains.

The next sojourn in order of desirability is inland, preferably at the mountains, for the entire summer.

The least desirable is at the seashore for the entire summer.

It is not to be understood that many children will not do well if kept at the seashore throughout the hot months. Some, indeed, improve most satisfactorily, but from observing our own patients we have repeat-

edly been impressed with the disadvantages of a too prolonged stay at the seashore. If kept there during August, infants are apt to show signs of lassitude, and while not ill, they do not return to the city in the autumn with the vigor, appetite, and general robustness which characterize those from the hills and mountains. It must be remembered that only New York City children are referred to. Children whose home is a seaport thrive best when given the benefit of a complete change to the dry, invigorating air inland. Children with catarrhal tendencies, bronchitis, or adenoids (before or following operation), and children who have had attacks of rheumatism or who show rheumatic tendencies, should not go to the seashore, wherever their residence. For an inland resort, the mountains, by which we understand an elevation of 1500 to 2000 feet, are not always essential. The place selected, however, should be at an elevation at of least 600 feet. For cases of chronic bronchitis and rheumatism a soil of sand or gravel is best, and the sleeping-room of the child should always be above the ground floor.

Other points to be considered in connection with the summer outing are the kitchen facilities, which must be ample. Often the larger hotels refuse the right of way to the kitchen. In this respect much more liberty is given in the smaller hotels and boarding-houses. The proper preparation of the child's food in the cramped quarters of sleeping-rooms is not impossible, but is often difficult and always objectionable; therefore, if a cottage is available, it will be greatly to the child's advantage.

Before final selection of a home for the summer the drainage, and the source and quality of the milk supply should receive the most careful attention. Country well-water or spring-water should ordinarily be boiled before using.

### INSTRUCTIONS FOR THE SUMMER

In addition to advising parents as to a selection of a summer resort for the family the physician must advise the mother as to the particular care of the child during the summer, whether he is to remain in town or go to the country. During the months preceding the heated term every mother whose infant is under supervision should be made aware of the dangers of the next few months, and receive written directions as to how to pass through the summer with the greatest security.

**Selection of Milk.**—The mother is told what market milks are the best. She is told that the milk must be kept on ice, with ice surrounding the bottle, from the time of its delivery until it is given to the child, except, of course, during the time spent in its special preparation.

**Reduction of Food Strength.**—During the hot months in the city the child's digestive capacity is not equal to that of the colder months. Children who remain in the city are given weaker milk mixtures, in which the fat and protein are reduced from 15 to 25 per cent. by diluting with water, the sugar remaining the same. The infant may not gain very much in weight, but on a reduced diet he is much more capable of passing through the summer without intestinal disorders, and has abundant opportunity to gain later.

**Clothing.**—Mothers are instructed as to the amount of clothing re-

quired. They are told that a napkin, a muslin slip, a loose-mesh knitted band, are all that are required on a very hot day.

**Water to Drink; Bathing.**—They are instructed to give the infant frequent drinks of boiled water between feedings, and if he suffers much from the heat, as shown by prickly heat and restlessness, to give him two or three spongings daily with a cool solution of bicarbonate of soda, 1 teaspoonful to a pint of water.

Both nursing and bottle babies as a rule do not need much water between feedings. On very hot days, however, when the child perspires a great deal an ounce or two of water may be given occasionally between the usual feedings.

**Withdrawal of Milk.**—It is made very plain that either vomiting or a green, undigested stool is a danger-signal which always means that the milk must be withheld for twenty-four hours or longer whether the child is nursed or bottle fed, and that either barley-water or one of the other carbohydrate gruels (p. 94) must be substituted until such time as the stools improve or the vomiting ceases. This is one of the most important life-saving measures the physician can teach the mother.

An immense majority of the intestinal diseases of summer, which destroy thousands of lives yearly, have their origin in neglected acute indigestion and diarrhea, which if properly managed would mean a slight illness of but a day or two.

It is further impressed upon the mothers that upon resuming the milk it must be given at first greatly reduced in strength, and then gradually increased until food of the usual strength is given. Beginning with  $\frac{1}{2}$  ounce of skimmed milk in each feeding, by watching effects upon the temperature and the stools, one may make an increase of perhaps 1 ounce each day.

**How to Obtain Safe Milk.**—Not a little trouble in the past has been experienced in securing safe milk for infants who were removed at a considerable distance from the depots of the better class of dairies that supply certified milk. In remote country districts, where the milk is furnished by the farmer, a special arrangement may be made, by which he agrees that the cow's belly, udders, and teats shall be wiped off with a damp cloth before milking; that the milker's hands shall be washed before milking; that the few jets of the foremilk shall be thrown away; and that as soon as the milk is drawn it shall be strained through absorbent cotton into a quart milk bottle, suitably corked, and placed in a pail of cracked ice. The cracked ice and the absorbent cotton are, of course, to be furnished by the consumer. For the extra trouble the farmer should receive a special price for the milk. At one resort three babies were supplied in this way, by one small producer, with a comparatively safe milk. The improved covered milk pail insures a much cleaner milk, as it offers much less opportunity for droppings to fall into it during the milking than does the old-style pail.

For those who have country homes and who can control their milk-supply the above precautions may be carried out to the letter. By such careful control of the home product, and by the use of milk from those dairies only which observe the above precautions, the acute digestive disorders of summer among patients have been rendered very unusual.

These precautions, with the knowledge of the mother or nurse as to what to do at the first sign of a digestive disorder, will reduce the number of the so-called summer diarrhea cases to a very insignificant figure.

Among out-patients in large cities who have to use other milk and milk less clean, summer diarrhea must prevail. Among these, however, the death-rate has been remarkably reduced through the education of the mothers.

The mothers are told that a diarrhea is never without dangers; that an infant who has frequent attacks of indigestion during the cooler months is very sure to develop diarrhea during the hot months, and that the safest means of keeping a baby well in the summer is to keep him well all the year round.

#### RULES FOR THE CARE OF DISPENSARY INFANTS AND YOUNG CHILDREN DURING THE SUMMER

1. *Clothing*.—During the very hot days the baby should wear a napkin, a thin gauze shirt, and a thin muslin slip. An abdominal binder made of thin material, and loosely applied, may be worn until the child is six months of age.<sup>1</sup>

2. *Bathing*.—Every child should have one tub-bath daily. On very warm days from two to four ten-minute spongings with cool soda water (1 teaspoonful of bicarbonate of soda to a pint of water) will greatly add to the child's comfort.

3. *Fresh air* is of vital importance. Leave the windows open. Keep the child in the open air when possible. Avoid the sun. Select the shady side of the street and the shade in the parks.

4. *Sleep* is very necessary for growing children. A noon-day nap of at least two hours should be insisted upon until the child is four years of age.

5. *Soiled napkins* should be placed in some covered receptacle containing water, and washed at the earliest opportunity.

6. *Drinking-water*.—Boil 1 quart of water every morning. Put it into a clean bottle. Keep the bottle in a cool place. Give the water between the feedings—as much as the child will take.

7. *Breast Feeding*.—The mother should wash the nipple with plain cold water before each nursing. She should be very careful as to her diet and habits of life. Her bowels should move once a day. Constipation in the mother produces illness in the child. The mother should have three plain, well-cooked meals daily, consisting largely of milk, meat, vegetables, and cereals.

*From birth to the third month*: The baby should be nursed at three-hour intervals during the day. Seven nursings in twenty-four hours, with only one nursing between 10.30 p. m. and 6 a. m.

*Third to sixth month*: The nursings should be at three-hour intervals during the day; six nursings in twenty-four hours, with no night nursing.

*Sixth to ninth month*: The child now takes a larger quantity at each feeding and should be nursed at four-hour intervals; five nursings in twenty-four hours.

*Ninth to twelfth month*: The nursings should be at four-hour intervals; five nursings in twenty-four hours.

8. *Bottle Feeding*.—The bottle should be thoroughly cleansed with borax and hot water (1 teaspoonful of borax to a pint of water) and boiled before using. The nipple should be turned inside out, and scrubbed with a brush, using hot borax water. The brush should be used for no other purpose. There should be three or four sets of bottles and nipples. The bottles and nipples should rest in plain boiled water until wanted. Never use grocery milk. Use only bottled milk which is delivered every morning. The milk should be boiled for five minutes immediately after receiving. The feeding hours are the same as in breast feeding. Children of the same age vary greatly as to the strength and amount of food required. Food, when prepared, should be poured into a covered glass fruit-jar and kept on the ice. For the average baby the following mixtures will be found useful:

*For a child under three months of age*: Nine ounces of milk, 27 ounces of boiled water, 4 teaspoonfuls of granulated sugar. Feed from 3 to 4 ounces at three-hour intervals—seven feedings in twenty-four hours.

*Third to sixth month*: Eighteen ounces of milk, 30 ounces of barley-water, 6 teaspoon-

<sup>1</sup> After this age the binder, although not necessary, is still desirable. Even in tropical countries the "belly band" is held in great repute as a prophylactic in forestalling intestinal disorders.

fuls of sugar. Feed 5 to 6 ounces at three-hour intervals—six feedings in twenty-four hours. No night feeding.

Barley-water is prepared by boiling a tablespoonful of prepared barley flour in 1 pint of water for twenty minutes; strain and add water to make 1 pint.

*Sixth to ninth month:* Twenty-four ounces of milk, 24 ounces of barley-water, 6 teaspoonfuls of granulated sugar. Feed 7 to 8 ounces at four-hour intervals—five feedings in twenty-four hours.

*Ninth to twelfth month:* Thirty-eight ounces of milk, 12 ounces of barley-water, 6 teaspoonfuls of granulated sugar. Feed 7 to 9 ounces at four-hour intervals—five feedings in twenty-four hours.

9. *Condensed Milk.*<sup>1</sup>—When the mother cannot afford to buy bottled milk, when she has no ice-chest or cannot afford to buy ice, she should not attempt cow's milk feeding. Canned condensed milk should be used as a substitute during the hot months only. The can, when opened, should be kept in the coolest place in the apartment, carefully wrapped in clean white paper. The feeding hours are the same as for fresh cow's milk.

*Under three months of age:* One-half to 2 teaspoonfuls condensed milk; barley-water No. 1 (see Formulary, p. 94), 2 to 4 ounces.

*Third to sixth month:* Condensed milk, 2 to 3 teaspoonfuls; barley-water, 4 to 6 ounces.

*Sixth to ninth month:* Condensed milk, 3 to 4 teaspoonfuls; barley-water, 6 to 8 ounces.

*Ninth to twelfth month:* Condensed milk, 4 to 5 teaspoonfuls; barley-water, 8 to 9 ounces.

10. *Feeding After One Year of Age.*—All babies should be weaned at the age of twelve months unless other orders are given by a physician. The bottle fed, also, at this age require more than milk and cereal water. During the second year children are almost invariably badly fed.

Four meals a day should be given at the same hours every day. The mother will select suitable meals from the following articles: soft-boiled egg; scraped rare beef; strained broth of beef, mutton or chicken, with stale bread broken into it; toast and butter; stale bread and butter; toast and milk; stale bread and milk; oatmeal (cooked three hours) and milk; hominy (cooked three hours) and milk; cornmeal (cooked two hours) and milk; farina (cooked one hour) and milk. The milk used must be boiled during the hot weather.

### DAYS TO GO OUT-OF-DOORS; INDOOR AIRING

Physicians are frequently consulted as to the age when, and the conditions under which, it is permissible to take the baby out-of-doors. To answer this, the place in which the child lives, the season of the year, and the age and condition of the patient must be taken into consideration.

A child, regardless of the age, should never be taken out in inclement weather. If under one year he should not go out if the temperature is below 20° F. During the midday heat of summer the baby is better off in the largest and coolest room in the house or on a shady veranda. On very windy days the young infant should not go out; neither should he go out when the snow is melting in large quantities.

When going out, on account of unfavorable conditions of the weather is prevented, there should, however, be no lack of fresh air, and this may be insured if the child be given an *indoor* airing, dressed as for the daily outing. All the windows of the nursery or some other large, sunny room should be opened on one side of the room only. The doors should be closed, so that currents of air are avoided. The child should then be placed in his carriage, suitably covered, and left in the open room all day, except when he is fed and "changed." Here he receives most that is good from outdoors and avoids much dust and moisture that is objectionable outside.

This method will be found very useful in caring for "winter babies"

<sup>1</sup>Evaporated milk is a suitable substitute. (See p. 79.)

—those born during the late fall or winter months. The indoor airing may be given for a week or more before the infant is taken out. By this means the child may be gradually accustomed to a change of temperature from that of the average living-room to that out-of-doors, and will not be harmed when finally taken out. After an illness, furthermore, indoor airing will afford a means of returning earlier to the daily outing. This indoor method of giving a child fresh air will be found useful with very delicate children also, who, by reason of their condition, may be unable to go out during the winter months for several weeks at a time. Few days during the winter are too cold or too stormy for the indoor airing.

#### THE EXERCISE PEN

In another chapter, in speaking of "colds," and how children are exposed to the influences which may bring about what is known as a

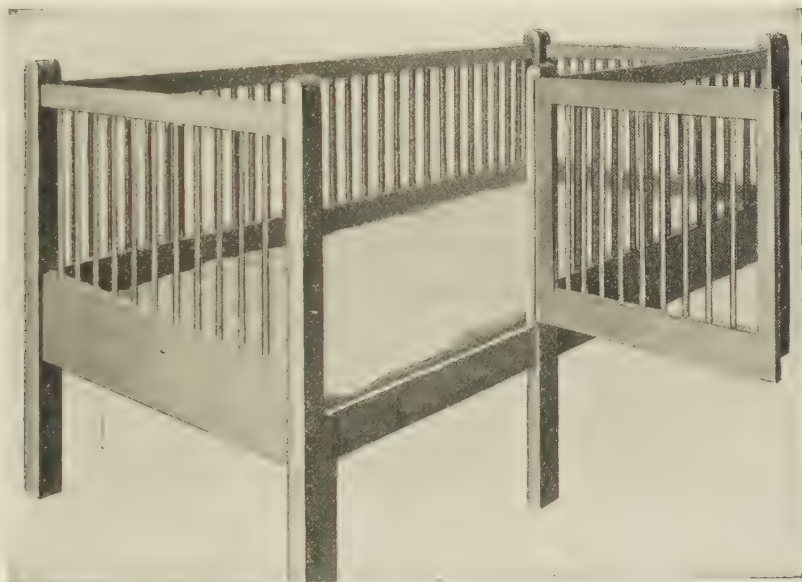


Fig. 148.—The exercise pen.

"cold," the custom of allowing a child to sit on the floor and play at all seasons of the year has been referred to as a most frequent means of exposure. There is always a current of air near the floor, as one readily discovers by resting his hand on the floor on a cold winter day; further, the floor of the average house is naturally the most unclean part of the dwelling. Here dust gathers and dirt from the street collects as it is brought in on the feet of older members of the family. On this necessarily unclean floor the young child is often permitted to spend a considerable portion of his waking hours. It may readily be seen that countless numbers of bacteria may be transferred through the medium of the hands from the floor to the child's mouth. Rugs and pillows, which are sometimes used, while cleaner than the floor, are of little assistance in preventing drafts.

Exercise is very necessary for the child's proper growth and development. He must have an opportunity and place in which to creep, walk, and run. In order that he may have these advantages and not be subjected to unfavorable influences the exercise pen (Fig. 148) has been devised. After being bathed, dressed, and fed the child is placed in the pen on a rug or quilt. Toys are given him and the door is closed. He cannot come in contact with the stove, he cannot roll downstairs, and he is in no danger from the rough play of older children. He is given an opportunity for active exercise without a possible chance of injury.

*Specifications:*

The pen can be made of any size, but the usual size is 4 feet square. It can be made of any light-weight wood, pine generally being used. The legs should be at least 12 inches long, bringing the enclosure well off the floor. The pen should be so constructed that it may readily be taken apart and put together again, iron tenon hooks and iron mortices being used to hold the parts together. The floor may be made of any thin material. One-half inch pine boards nailed together, or papier-mâché supported by narrow strips of board, may be used. The floor may be supported by strips of board about  $\frac{1}{2}$  by 2 inches, which are fastened to the inner sides of the end-pieces. The pen is best placed in the corner of the nursery or the living-room. Its size may be determined entirely by the size of the room. During warm weather in the country the pen may often be used out-of-doors.

### COLD SPONGING IN FEVER

Sponging with plain water, with salt water (a teaspoonful of salt to a pint of water), or with alcohol and water (1 part alcohol to 3 parts water) is a means of reducing high temperature, with which every physician should be familiar. Cool sponging at 75° to 80° F., with plain or medicated water is useful for two purposes: as a sedative and for the reduction of fever. In measles or scarlet fever, although the temperature may not be high, the itching and burning of the skin prevent sleep, and the patient is very uncomfortable, but often, under such conditions, he will fall asleep during a careful sponging. In pneumonia, in typhoid fever, and in the intestinal disorders of summer, nurses may well have a standing order to give a cool sponging for fifteen minutes at any time when, in their judgment, it may be indicated, not on account of the fever, but because of the sedative effect upon the patient. A sponging of ten to fifteen minutes three or four times a day with cool water (65° to 75° F.) will greatly help a baby, whether sick or well, to pass successfully through the hot period of summer.

Sponging for fever, while possessing less antipyretic value than do other measures, such as a cold pack, for example, has the advantage that it is safe and easy of application in the hands of the most unskilled, and is of assistance in influencing high temperature when other means are not available. In order not to antagonize or frighten timid children it is often wise to begin with the water at 95° F., and reduce the temperature gradually by the addition of cold water or small pieces of ice. It is rarely necessary to go below 60° F., and usually the sponging should not be continued longer than thirty minutes. It is well to have an interval of rest—from thirty to ninety minutes—between the spongings, as too frequent sponging, if resisted, may exhaust the patient. Every part of the body should be sponged in turn, but it is not necessary to expose the patient, who should be covered with a flannel blanket. When the pro-

cedure is completed, the skin should be briskly rubbed for a few minutes with a dry, rough towel.

### THE COOL PACK

The cool pack, properly applied, is free from the slightest danger to the patient, and is the best means we possess with which to combat a continued high fever. The pack may be used as freely and with as much success in treating the exanthemata as in dealing with typhoid fever or pneumonia. That cool water may not safely be applied to the skin of a child with scarlet fever or measles is a fallacy which it is our duty to expose to mothers.

The pack is prepared as follows, a rubber sheet being used to protect the bed-sheet: A large bath-towel, or some thick, soft, absorbent material, should be used. Muslin, linen, or any thin material does not answer so well. Slits are cut in the towel large enough for the arms to pass through, and the towel is folded around the body, enveloping only the trunk and buttocks (Fig. 149). The pack should not extend below the middle of the thighs. This leaves the arms and the greater part of the lower extremities free. A hot-water bag, carefully guarded, should be placed at the feet and the patient covered with a blanket of medium weight. The towel is moistened with water at 95° F. This higher temperature is necessary at first in order not to frighten the patient, as sudden cold is apt to do, and also to avoid shock. In two or three minutes the towel, without being removed, is again moistened with water at 90° F., later with water at 85° F., and still later, at 80° F. When the temperature of the water reaches 80° F., it should be maintained at this point for half an hour; then the patient's temperature should again be taken. If at the beginning his temperature was 105° F. and now shows little or no reduction, the temperature of the water with which the towel is moistened should be reduced to 70° F., or, if necessary, even to 60° F. The child, throughout the treatment need not be disturbed, except to be turned from side to side in order that the towel may be wet with water of the desired temperature, this being one of the advantages of the pack over a tub-bath or sponging. The towel, or other application employed, should not be used for more than six hours without being replaced by a fresh one.

For the first hour or two in a pack the temperature of the patient should be taken every half-hour. When the fever is reduced to 102° F. the pack should be removed, for, if it is continued longer, too great a reduction may take place. If the fever rises again rapidly to 105° F. or higher it is well to keep the patient in the pack continuously. The degree of cold necessary, in the individual case, to keep the temperature within safe limits will soon be learned.

A boy four years old with lobar pneumonia was kept in packs for seventy-two hours. In this case a continuous pack at 70° F. was required to keep the body temperature at 104° F. or slightly lower.

Another reason for frequently taking the temperature is that, early in the attack, we do not know how the fever will be affected by the continued cool applications. In some children it is very readily influenced, and in such a case collapse might follow a very sudden reduction of the

temperature. In cases readily controlled, the pack may be necessary for only one-half hour or an hour, at intervals of three or four hours. An ice-bag may with advantage be kept at the head when the child is in the pack. Suddenly enveloping the entire skin surface in a cold sheet at 70° F., as advocated by some writers, may increase the temperature and occasion grave symptoms of impending death, because of the sudden contraction



Fig. 149.—The cool pack.

of the superficial blood-vessels, which sends the blood to the viscera, producing congestion of the internal organs.

### BATHS

The newborn child should be given, daily, a basin-bath with lukewarm, boiled water and Castile soap until the cord falls and the navel heals. When this has taken place, the tub-bath may be given. The temperature of the bath for the very young infant should not be below 95° F. nor above 100° F. Very young infants should not be kept in the water more than three minutes. After the third or fourth month a temperature of 90° to 95° F. is best, the child being kept in the water about five minutes. At this age the tub-bath is best given at night, just before the baby is put to bed. A basin-bath may be given in the morning. When the child is a year old and fairly vigorous, the temperature of the water at the beginning of the bath should be 90° F. This should gradually be reduced to 80° F. by the addition of cold water, the child being vigorously rubbed with the hand while in the water. The temperature of the room should be from 76° to 80° F. during the bath, and windows and doors should be closed. When removed from the tub the child should be dried quickly and thoroughly, the folds of the skin being well powdered. A sponge should never be used at any stage of the bathing process and should never be included in the nursery outfit. Sponges are never clean after they have once been used.

Some children have a dread of the bath, and cry frantically when placed in the water. This is due to fear, and may usually be overcome by placing a sheet over the tub and lowering the child on the sheet into the water.

**The Cold Douche.**—For "runabouts" from two to three years old it may not be wise to use water below 70° F., but during the entire twelve months many children over three years have a cold douche after the

cleansing bath at the temperature at which the water runs from the faucet. In winter, in New York houses, this ranges from 50° to 60° F.

In giving the cool douche the child should stand in warm water covering the ankles. The douche may be used in the form of a spray or shower, or the water may be applied by means of a sponge at the desired temperature. The head, if the shower or spray is used, should be suitably protected by an oilskin or rubber bathing cap.

After the cold douche there should be a vigorous friction of the skin with a rough towel. If there is not a quick reaction, if the skin does not become warm and glowing, warmer water should be used. So also if there is blueness of the extremities and "goose flesh," water less cold should be used, but the douche should not be discontinued.

In the great majority of homes the bathing of the child can be carried on with greater convenience immediately before bedtime. He should receive the warm bath and the cool douche, and then, in night-clothes, a warm wrapper, and suitable foot covering, should eat his supper. However, if this time is not convenient, he may be given the evening meal at 5.30 or 6.30, and one hour later have the bath and go to bed.

**Tub-baths for Fever.**—Place the child in water at a temperature of 95° F. and reduce to 80° or 75° F. by the addition of ice or cold water. The duration of the bath should not be more than ten minutes. Constant friction should be maintained during the entire process.

**Basin Bathing for Fever.**—Add 8 ounces of alcohol to a quart of water at a temperature of 70° F. The child is stripped, covered with a flannel blanket, and the entire body sponged with this solution for ten or fifteen minutes. Drying the skin should not be practised. Allow the alcohol and water to evaporate from the body surface, as by this means a greater reduction in the temperature will be effected.

Either the tub-bath or the basin-bath may be used by the mother in case of sudden high fever—104° to 105° F.—before the physician arrives. She should be so instructed.

**Bathing for Comfort in Hot Weather.**—The basin-bath and tub-bath may also be used as a means of relief during very hot weather. One or two basin-baths a day, with a tub-bath at bedtime during this trying season, will give the child much relief, and help him to pass safely through the heat period. The very young feel the extreme heat most acutely, and endure it with difficulty. Nothing else will give a restless, uncomfortable, heat-tormented child such a refreshing sleep as a cool tub- or basin-bath.

**Mustard Bath.**—A mustard bath is prepared by adding a heaping tablespoonful of mustard to 6 gallons of warm water. A time allowance of five to ten minutes for the bath is all that is advisable. The special use of the mustard bath is in the treatment of convulsions. This measure will be found useful also for nervous children who sleep badly. Two or three minutes in the mustard water, followed by a quick rubbing immediately before going to bed may prove all that is required to induce refreshing sleep.

**Brine Bath.**—A brine bath—4 even tablespoonfuls of salt to 1 gallon of water at a temperature of 95° F. is of great service with very delicate, poorly nourished children. Its action is that of a tonic. If the body is

thoroughly soaped and washed with plain water and then immersed in the brine bath, no further rubbing is necessary. Ordinarily, the child should be kept in the bath for five or ten minutes, constant friction being continued during the entire time. The brine bath is not applicable to children with intertrigo or eczema.

**Soda Bath.**—The soda bath is of some service in cases of prickly heat, from which many children suffer during the summer. A table-spoonful of bicarbonate of soda should be added to each half gallon of water used. The temperature of the water should be that to which the child is accustomed. From two to four minutes in the water suffices. There should be little or no friction of the skin. It should be dried with soft towels.

**Bran Bath.**—The bran bath also is of service in treating prickly heat. One cup of bran is mixed with the water in the bath-tub and the same method employed as for the soda bath.

**Starch Bath.**—The starch bath is also useful for soothing an irritated skin. One-half cupful of powdered laundry starch is mixed with the water in the bath-tub, and the same method employed as for the soda bath.

**Hot Bath.**—The child is placed from three to five minutes in water which has been raised to a temperature of 105° to 110° F. Constant friction of the extremities is maintained during the bath.

### BATHING IN ILLNESS

There is a pronounced objection among many to bathing children when ill, particularly when they are suffering from respiratory diseases or from the exanthemata. The functions of the skin as an organ of excretion and elimination are most important, and it is absolutely necessary that, during illness, when the metabolic processes of the body are being carried on to an excessive degree, all the eliminating organs be kept in the best possible condition in order that they may the better do their work. There is no better means of stimulating the skin to a sharp reaction than bathing with weak salt water—a teaspoonful of salt to a gallon of water—at a temperature of 85° to 90° F., followed by a brisk rubbing. Every sick child should receive a sponge-bath at least once daily. It is the sudden contact of cold air with the moist skin, which occurs sometimes in undressing a child, without the attendant reaction, that causes the shock, the “cold,” which is usually attributed to the bath. It is the temperature of the room in which the child is undressed, the careless method of bathing, and not the application of water, which cause the trouble. Even the danger of this exposure is greatly overestimated. In order to avoid every possible danger, however, the temperature of the room in which the sick or delicate child is bathed should be raised to 80° F. We have yet to know of a patient who has suffered from effects of a bath properly given and we know of hundreds who have suffered because of its omission.

### HEAT THERAPY

Heat has long been used as a therapeutic agent. For infants and children it has a wide range of usefulness, both as dry heat and when conveyed by the use of water as a vehicle.

**Moist Heat.**—Heat, conveyed by water, is used as follows:

*In colic and indigestion and as a diuretic, internally.*

*In acute gastritis, as a sedative, taken by sipping.*

*In convulsions, idiopathic and uremic, by means of baths.*

*In convulsions, idiopathic and uremic, in colon flushings at 105° to 110° F.*

*In colic, in the form of a hot stupe applied to the abdomen.*

*In torticollis, as a hot compress to the neck.*

*In sprains, as a hot compress to the joint or muscle.*

*In acute articular rheumatism, as a hot compress to the joint.*

*In retention of the urine, as a hot compress applied to the lower abdomen and bladder.*

*In suppression of the urine (acute nephritis), in the form of a poultice or hot compress over the kidneys and in colon flushings, 105° to 110° F.*

*In cerebrospinal meningitis, as a hot bath or hot compress to the trunk and lower extremities.*

*In pleurisy, as a hot compress to the painful area.*

*In acute angina, as a gargle.*

*In conjunctivitis, as a hot compress.*

*To hasten suppuration in an abscess, as a poultice or compress.*

*In retropharyngeal abscess and in peritonsillitis (quinsy), as a throat douche.*

*In earache, as a douche or by means of a hot-water bag.*

*In toothache, by means of a hot-water bag, or as hot water held in the mouth.*

*In facial neuralgia, by means of a hot-water bag.*

*In prematurity and in lowered vitality or reduced temperature after disease, by hot-water bags or bottles.*

**Dry heat** is used in the following conditions:

*In prematurity, lowered vitality, or reduced temperature after disease, by means of the electrotherm.*

*In suppression of the urine (acute nephritis), by the electrotherm or by hot air.*

*In myalgia, arthritis, and incomplete restoration of function after fracture, by the electric oven.*

*In various forms of dermatitis and for the healing of granulating burns, by the electric-light bath.*

**Precautions.**—In using heat with children caution should be exercised as to the degree employed. Serious burning accidents have occurred by the use of hot-water bottles and hot compresses. When used very hot the hot-water bottle should be guarded by wrapping it in flannel. Moist heat in the form of compresses, poultices, and stupes should always be tested by placing them against the face of the attendant. The adult hand will often bear a greater degree of heat than is safe to apply to the skin of an infant or young child. In using hot packs, hot-water bags, the electrotherm, or dry heat generated by a lamp or other device, a thermometer should be placed between the child's clothing and the bed-clothing. A temperature of 110° F. is the highest safe to use with children. When water is the vehicle, the patient must be most carefully

watched and the application frequently renewed because of the rapid evaporation. A compress or poultice must not be allowed to get cool. A piece of flannel or oiled silk or rubber tissue over a hot compress will obviate the necessity for frequent changes.

### COUNTERIRRITATION

The counterirritants found especially useful in pediatrics are mustard, capsicum, turpentine, camphor, chloroform, and iodin.

Counterirritants are useful for two purposes—for the relief of pain and for effect upon internal inflammation and congestion. Without doubt the disease conditions in which counterirritation is of most value are the acute affections of the respiratory tract, such as bronchitis, bronchopneumonia, and pleurisy. In acute bronchitis, when the terminal bronchi are involved, when there is cyanosis and rapid respiration—from 60 to 80 per minute—keeping the thorax enveloped in a mustard plaster, 1 part mustard to 2 of flour, until the skin is well reddened, will often reduce the respirations from 20 to 30 per minute, so that the child, previously tossing and restless, will fall asleep. Repeatedly nurses and mothers have asked if the counterirritation in such cases could not be applied more frequently because of the apparent relief experienced by the patient. The applications may often be made with advantage at intervals of from four to six hours. The counterirritant should be sufficiently strong to produce the desired redness of the skin in from five to ten minutes. This will usually be produced by using at first 1 part of mustard to 2 of flour. When the skin becomes tender from the repeated applications, but 1 part of mustard to 5 or 6 of the flour may be required. If the plaster is made too weak, it must remain long in contact with the skin, which thereby becomes macerated.

**Indications.**—*In Acute Inflammations of the Respiratory Tract.*—When the bronchitis is of the asthmatic type, characterized by decided bronchial spasm associated with bronchial catarrh, the counterirritation furnishes not a little relief. In this condition the whole thorax should be enveloped. In bronchopneumonia with considerable bronchitis local applications of mustard over the involved areas are to be advised. The pain from pleuritic inflammation occurring independently of, or at the onset of, lobar pneumonia, or developing during bronchopneumonia, may be considerably relieved by counterirritation. Here also the mustard should be used only over the painful area. When the pain is severe, equal parts of mustard and flour may be used for the first application, if carefully watched, for the reason that a quick, sharp skin reaction should be produced.

The mother or nurse should always be cautioned to watch the skin under a counterirritant so that a blister shall not be produced. In no condition is it necessary to blister a child's skin.

We have no evidence that there is any curative action beyond that of a sedative retarding the inflammatory process within. That a respiratory disease is ever aborted by these methods, as claimed by some, is, however, exceedingly doubtful.

During the stage of engorgement and congestion of the bronchi, indicated by roughened or sonorous breathing with occasional sibilant

râles, brisk counterirritation with mustard, or with camphorated oil and turpentine, appears frequently to hasten the progress of the case toward recovery. If the turpentine is used with the camphorated oil, the proportion should be 1 part of turpentine to 2 parts of the camphorated oil. The mixture should be well shaken before use and applied vigorously with the hand for ten minutes or until a distinct redness of the skin is produced. The mustard or the turpentine should be used in these cases at least three times a day. Rarely in susceptible individuals turpentine applications may cause albuminuria. Capsicum vaselin may be used in the same way and for the same purpose as the camphorated oil and turpentine.

*In Colic.*—In severe colic a turpentine stupe will often furnish prompt relief, 20 drops of turpentine being mixed with 1 pint of water at 106° F. Into this a piece of flannel is dipped, then wrung sufficiently dry not to moisten the bed-clothing, and placed over the abdomen. Over the moist flannel is placed a dry flannel and oiled silk so as to retain the heat and moisture. The application may be renewed, if necessary, every fifteen or twenty minutes.

*In Pleurisy and Empyema.*—When adhesions exist after empyema or pleurisy, while the pain is not acute, there is an uncomfortable drawing, dragging sensation in the chest, which may persist for months. This has been relieved in a few cases by the tincture of iodine, U. S. P., painted over the painful parts every third or fourth night.

*In intercostal neuralgia*, not infrequently found in overworked school-girls, the repeated application, at intervals of three or four days, of tincture of iodine over the point of exit of the involved nerve will often be followed by complete cessation of the pain.

*Acute Articular Rheumatism.*—For the pain in acute articular rheumatism, chloroform liniment, U. S. P., may be applied to the joint, or, better, the solution of lead and opium, U. S. P., may be applied warm by means of old linen covered with oiled silk.

#### COLD AS A THERAPEUTIC AGENT

In the treatment of children cold is generally used in the form of compresses, baths, or packs, and is indicated in the following conditions:

*In tonsillitis, acute pharyngitis, and headache*, in the form of a cold compress.

*In meningitis and pyrexia*, by means of the ice-bag or the cool coil.

*In appendicitis*, by means of the ice-bag.

*In endocarditis and pericarditis*, by means of the ice-bag.

*In fever*, by means of baths, cold packs, sponging, and for older children, by colon flushings. (Not lower than 70° F.)

*In adenitis and in threatened superficial abscess*, by means of an ice-bag.

*In hysteria and neurotic states*, as a spinal douche.

*In malnutrition of older children*, as a tonic, by means of a moderate cool spinal douche following a warm bath.

For further details as to the application of cold in special diseases the reader is referred to the discussion of the diseases in question.

## BLOOD TRANSFUSION AND INTRAMUSCULAR INJECTION

Blood transfusion<sup>1</sup> has been practised in some form since the discovery by Harvey of the circulation; and devices to accomplish the transfer of blood were employed by Folli, and des Gabets, a Benedictine monk, as early as the middle of the seventeenth century. Authentic accounts exist recording successful operations in transfusion by Richard Lower and by Jean Denys in the years 1666 1667. In 1667 Denys and King successfully transfused blood from a sheep to a man by means of two cannulas united by a section of carotid artery taken from a horse or ox. As a means of injecting blood the syringe was employed by James Blundell in 1818. Later forms of apparatus were all modifications of a direct connecting mechanism of some sort, such as that of Lower, or of a "conducting system" supplemented by an "impellor" or syringe.

During the past quarter of a century the practice of transfusion which for many years was held in disrepute because of fatalities (many of which were due to antagonistic action between the blood of donor and that of recipient), has been revived with remarkably good results, and the technic has been simplified sufficiently to render the operation relatively free from risk in ordinary hands.

The successful but difficult methods of Carrel and Crile have now given place to three methods which are in general use: (1) the Lindemann syringe and cannula method, together with the Unger<sup>2</sup> modification which consists in the employment of a stop-cock controlling a syringe which transfers the blood from donor to recipient, at the same time permitting the systematic flushing of the connected cannulae with saline solution from a second syringe which forms part of the apparatus; (2) the Klimpton paraffin cylinder method<sup>3</sup> in which the total amount of blood to be transfused is collected in a paraffin-lined cylinder and then introduced into the vein of the recipient; (3) the citrate method, in which the drawn blood is mixed with a sterile 2.5 per cent. sodium citrate solution to prevent coagulation, and then injected by gravity into the recipient's vein. The choice of method is a matter of familiarity with and perfection of technic, but it has been maintained that there are more post transfusion reactions with the citrate method than with the unmodified blood methods.

Most of the bad results ascribed to transfusion in the past have been due either to incompatibility of blood, *i. e.*, "hemolysis or agglutination of the red blood-cells of either donor or patient by the serum of the other," or to failure to select donors free from infectious disease capable of transmission in the blood. Preliminary tests are, therefore, always essential to exclude the possible occurrence of hemolysis and to insure the absence of such types of blood infection as syphilis and malaria.

In testing donors for the transfusion of children the simple and rapid method of Rous and Turner<sup>4</sup> has proved entirely satisfactory. It consists of direct matching of drops from the two bloods, in different pro-

<sup>1</sup> Hooker and Satterlee in Johnson's Operative Therapeutics, vol. i, p. 337.

<sup>2</sup> Jour. Amer. Med. Assoc., lxiv, p. 582.

<sup>3</sup> Klimpton, Jour. Amer. Med. Assoc., July 12, 1913.

<sup>4</sup> Rous, Peyton, and Turner, J. R., Jour. Amer. Med. Assoc., June 12, 1915, vol. lxiv, pp. 1980-1982.

portions, under the microscope, without incubation in the ordinary sense of the term.

The indications for transfusion in children include severe secondary hemorrhages from whatever cause (whether typhoid fever or tonsillectomy), severe secondary anemia, the cause of which can be controlled, hemorrhagic disease of the newborn, purpura, and occasional cases of malnutrition or infectious disease.

In the actual application of transfusion in a child's case the external jugular vein or the median basilic is selected to receive the blood and the amount introduced is seldom over 7 ounces.

Repeated small transfusions seem to be more effective than a single large transfusion. In secondary anemias 8 to 10 c.c. of blood per pound of body weight has brought about marked improvement.

The advantages of *direct blood injection* over transfusion are considerable; the technic, which consists only in extracting the blood from the vein of the donor and injecting it intramuscularly, can be carried out by any physician. Tests for agglutination and hemolysis are not required.

The intramuscular injection of whole, freshly drawn blood in hemorrhage neonatorum has an almost specific curative effect, even in doses of 10 to 20 c.c. The blood is best injected into the glutei and need not be typed for compatibility.

*Illustrative Cases.*—This method has been repeatedly successful in absolutely controlling the hemorrhage in the writer's cases. In each, 1 ounce of blood was injected— $\frac{1}{2}$  ounce into each buttock.

Transfusion was used in treating a child who developed a severe purpura after diphtheria. There were extensive hemorrhages under the skin and uncontrollable bleeding from the nose and gums. Six ounces of blood was transfused by Lindemann, using his own method. The bleeding promptly ceased and the child recovered. There is no doubt that the issue would have been fatal had transfusion not been promptly employed.

A boy eight years of age developed severe influenza, double otitis media, double mastoiditis, and sinus thrombosis of the right side, for which operations were performed as the occasions arose. Recovery was proceeding slowly, and after three weeks of a most exhausting illness lobar pneumonia developed. It seemed that recovery was now impossible. The parents were advised that transfusion held out the only hope. Two transfusions were given by Lindemann, using his own method, with an interval of two days. At the first transfusion 8 ounces of blood was given; at the second, 6 ounces. The boy then recovered and was perfectly well two years after the illness. Beyond all doubt, recovery would have been impossible without the transfusions.

Transfusion in several cases of extreme secondary anemia in infants was followed by complete cure (p. 440). One case showed no improvement.

(For Transfusion in Acidosis see p. 777.)

## INTRAMUSCULAR MEDICATION

Intramuscular injection of drugs and other substances is a common procedure. The sites most commonly used are in the glutei, the triceps, the deltoid, the rectus femoris, and the pectoralis major. The skin over the area is cleansed in the usual manner and the needle is inserted through the skin deeply into the muscle. Beside the usual medicaments thus administered, special reference should be made to the intramuscular injection of neosalvarsan by the Rosen needle which has a curved phlange at the hilt. This method is discussed under the treatment of syphilis (p. 749).

## INTRAPERITONEAL INJECTIONS

Another route for the injection of fluids in extreme cases of dehydration is the intraperitoneal. By this method normal saline, 2 per cent. glucose, and 2 per cent. sodium bicarbonate solutions may be rapidly and safely injected.

The ordinary gravity set is used, the container being placed about 18 inches above the infant's body. The site of injection (about 2 inches below the level of the umbilicus) is thoroughly cleaned with soap and alcohol and painted with 2 per cent. tincture of iodine. Under strict asepsis the needle (No. 16 or 17 intravenous) is inserted in an upward direction through the abdominal wall into the peritoneal cavity, and the flow started.

It is essential that strict asepsis be observed and that the injected solution enter the peritoneal cavity at a temperature equal to that of the body, not less than 100° F.

This method has distinct advantages in the facility and rapidity with which it may be employed. Absorption from the peritoneum is rapid and complete.

## INTRAVENOUS MEDICATION

The intravenous method may be employed for the injection of normal saline, sodium bicarbonate solution, glucose solution, sera of various kinds, whole or citrated blood, or drugs. The commonest sites for such injections are: (1) the superior longitudinal sinus, (2) the external jugular vein, and (3) the median basilic or cephalic veins in the cubital fossa.

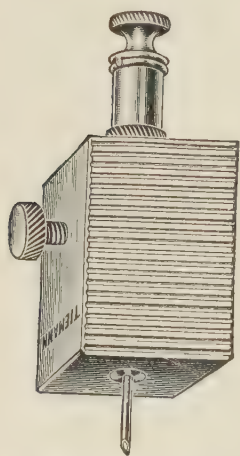


Fig. 150.—The Goldbloom needle.

1. *The Superior Longitudinal Sinus.*—The Goldbloom<sup>1</sup> needle (Fig. 150) has proved most satisfactory for use at this site. It consists of a beveled metal block 3 cm. in thickness, through which a needle 4 cm. long passes, leaving 1 cm. of the needle projecting. The length of the projecting portion of the needle may be varied and fixed by a set-screw. The scalp over the anterior fontanel is shaved, washed with green soap and alcohol, and painted with iodine. Under rigid asepsis the sterile needle is inserted in the midline at the apex of the posterior angle of the fontanel. The needle is pointed downward and backward at an angle of about 50 degrees until the sinus is entered. The obturator is removed from the needle and blood withdrawn or injection made. Injected solutions should be of body temperature and should be made slowly, with careful watching of the infant's color, pulse, and respiration. Upon completion, the needle should be quickly withdrawn and moderate pressure exerted on the site of puncture. A collodion dressing is applied.

This method is of great value in dealing with small infants whose superficial veins may be difficult to find and to handle. It should not be

<sup>1</sup> Amer. Jour. Dis. Child., 1918, vol. xvi, pp. 388-390.

employed when other veins can be readily entered, or without extreme caution in technic.

2. *External Jugular Vein.*—The skin over the sternomastoid muscle is cleansed and rendered aseptic in the usual manner. With muscular effort or crying the vein will be seen to stand out in the region of the sternomastoid. The needle is then inserted with one stroke through the skin and into the vein, keeping the line of the needle parallel with that of the body.

3. *Median Basilic or Cephalic Veins.*—The skin over the bend of the elbow is cleansed in the usual fashion, a tourniquet lightly applied above the elbow until the veins stand out, and the needle inserted at one stroke through the skin and into the vein.

When necessary the skin over the vein may be infiltrated with 1 per cent. novocain and a small incision 1 to 1.5 cm. in length made exposing the vein in the subcutaneous tissues.

Fluids or medication injected intravenously should be given by syringe or by gravity from a container a short distance above the level of the vein.

### HYPOTHERMOCLYSIS

Hypothermoclysis is one of the means employed to introduce drugs and fluids into the body by other than the gastro-intestinal route. This procedure is used chiefly after hemorrhage, in acidosis, in marasmus, and in active diarrhea in cases in which there has been excessive loss of bodily fluids.

In acidosis a 4 per cent. chemically pure bicarbonate of soda solution is employed, alone or with 4 per cent. of dextrose. From 4 to 6 ounces may be used at one time, and the injection repeated in four to six hours. In marasmus and diarrhea a sterile normal salt solution is used. Netter has claimed to have had signally good results in marasmus in the use of sterile sea-water. The amount of solution used varies with the age of the child or the object in view. From 2 to 4 ounces are usually employed.

In using the bicarbonate of soda after this fashion there is some danger of producing necrosis of the tissue at the site of the injection. This, according to Howland, may be obviated by sterilizing the solution by heat. The bicarbonate is then changed to the carbonate, and as the carbonate is very irritating, it must be changed back to the bicarbonate. This can be accomplished by passing carbon dioxid through the cold solution, to which a few drops of phenolphthalein have been added, until it becomes colorless.

That the danger of necrosis in using the chemically pure bicarbonate of soda in sterile water has been somewhat exaggerated would be suggested by the observations of a former associate, Dr. Mercer Blanchard, who used the 4 per cent. solution in treating 50 infants at the New York Nursery and Child's Hospital with but slight local irritation of very temporary duration.

The solution is introduced very slowly by gravity, the container being placed about 2 feet above the child's body.

## LAVAGE (STOMACH WASHING)

To Seibert is due the credit of first calling attention in this country to the value of stomach washing. Its use was soon appreciated by pediatricians generally, and at the present time it is an indispensable therapeutic measure. In the vomiting of children, whether due to pylorospasm, acute gastro-enteric infection, chronic indigestion, or a subacute attack of chronic gastritis, it is equally valuable. The dangers of stomach washing may be said to be practically *nil*.

A colleague a few years ago, while washing the stomach of a child two years of age, turned away for a moment, when suddenly the struggling child disconnected the tube from the glass connecting rod and swallowed the tube. Attempts at its removal through the bowel were unsuccessful; gastrotomy was performed, the tube removed, and the child recovered. This is the only accident of any kind we have ever known during stomach washing.

**The Operation.**—For lavage the child is easiest handled when the arms are pinned to the sides by a towel passing around the body. He may rest on his back in a crib, or sit upright on the lap of the nurse or mother. The clean left index-finger of the physician is placed upon the base of the patient's tongue. The tube, moistened with the fluid to be used in the washing, not with oil, is passed down over the base of the tongue into the esophagus. Passage of the tube into the larynx is practically impossible. We have washed the stomachs of many hundred children, and the introduction of the tube has never been attended with difficulty. When it has entered the esophagus, it should be passed rapidly into the stomach. At least 9 inches of the tube will be required to reach the lower portion of the stomach. At first the child will cough, retch, and become red in the face, but this need cause no alarm. He will soon cry and begin to breathe regularly. When the tube is in position the funnel should be held the length of the tube,  $2\frac{1}{2}$  to 3 feet, above the patient's body; the water, which should first be boiled, may then be poured into the funnel. At first the water may remain stationary in the funnel, owing to the pressure of air in the stomach and the straining of the child. When the child relaxes or the air escapes, being forced upward through the water, the water will pass rapidly into the stomach.

The apparatus described under Gavage (p. 853) is used. It should always be boiled before using. If much mucus is present, a 1 per cent. solution of boric acid or borax may be used. The amount introduced into the stomach at one time varies with the age of the child. For a baby of one week 1 ounce may be used; at six weeks, 2 ounces; at six months, from 4 to 6 ounces. It is rarely advisable to introduce more than 6 ounces at one time. The fluid is allowed to run into the stomach and is then siphoned out by lowering the funnel, the process being repeated until the fluid returns perfectly clear. From 1 to 2 pints of water may be necessary to complete the washing.

**Indications.**—It is rarely necessary to wash the stomach oftener than twice in twenty-four hours. Ordinarily, in the acute vomiting cases, one washing daily for four or five days will answer. In cases of chronic indigestion with regurgitation the washing will be needed less frequently—once a day or once every second or third day.

The following is frequently the history of a case of chronic indigestion with vomiting: There has been for several weeks vomiting of food and mucus two or three times daily. The stomach has been washed, the child carefully dieted with a plain barley-water or a weak milk mixture, and no vomiting has occurred for perhaps twelve to forty-eight hours, when the regurgitation or vomiting again commences as before. In such a case it will soon be learned how frequently the washings should be repeated in order to control the vomiting.

*Illustrative Case.*—A child six months old suffering from malnutrition had a history of persistent vomiting after each feeding. A greater part of the food taken was lost. What was not vomited was digested imperfectly, as was shown by the stools. The stomach was washed and a large quantity of thick mucus and curds removed. The child was given a barley-water diet. There was no vomiting for three feedings, and then only a small quantity of barley-water was ejected. After three days, following daily washings, the vomiting entirely subsided. The child was given a weak milk mixture, one-fifth milk and four-fifths barley-water, and no significant vomiting resulted. The food was carefully strengthened, and although in two weeks the vomiting had entirely ceased, the washings were continued at intervals of two or three days for a month until the water siphoned out was free from mucus.

In severe cases of chronic indigestion the washings at intervals of two or three days may be continued with advantage for several months. It must be remembered that in these chronic cases of indigestion the patient is ill through abuse of the stomach—usually because too strong food has been given, or too much of a suitable food has been given at too frequent intervals. As important, then, as the stomach washing is the giving of food suited to the child's digestive capacity.

The field of usefulness of lavage is not entirely confined to vomiting cases. Children with indifferent appetite and limited food capacity, but without vomiting, are often greatly benefited by the treatment. A not infrequent story is that food is taken without relish and that coaxing is necessary in order that the child shall eat. The loss of appetite is usually the result of improper food or faulty feeding methods. Some patients are absolutely indifferent to food; many refuse it altogether. In cases of this class a stomach washing once a day will often be followed by a surprising improvement in the appetite. There is no better appetizer for many of these pitiful looking babies.

In not a few instances we have been surprised at the large amount of mucus removed from the stomach of one of these children who had shown no vomiting whatever. The fact teaches us that there may be, in infants, stomach disorders of considerable importance without vomiting or, in fact, without any other symptom than loss of appetite and malnutrition.

## GAVAGE

Gavage, or forced feeding, is the introduction of nourishment into the stomach by means of a tube. The tubes are to be obtained at the instrument makers and are known as "stomach-tubes for children," or the physician can make one himself at a small cost. All that is required is a soft-rubber catheter, American No. 12, a  $\frac{1}{8}$ -inch glass tube 2 inches long, 2 feet of  $\frac{1}{4}$ -inch plain rubber tubing, and a small glass funnel. An extra opening should be cut in the catheter about  $\frac{1}{2}$  inch from the

outlet. This allows a more rapid introduction of the nourishment. The opening can very easily be made with a small pair of curved scissors.

The position of the child for gavage may be the same as for stomach washing, or the child may rest on his back. It is well to clear out the stomach with warm water before each feeding. In giving gavage to children without teeth the bare index-finger is all that is necessary to keep the mouth open. In handling children with teeth a dependable gag should be used.

**Indications.**—Gavage will be found useful in three types of cases:

*In Obstinate Vomiting.*—Several years ago, when the senior writer was resident physician at the New York Infant Asylum, a series of observations were made on cases of persistent vomiting which could not be controlled by stomach washing or ordinary methods of treatment. It was found that patients who could not retain a teaspoonful of water administered by a spoon or a bottle would retain from  $\frac{1}{2}$  to 1 ounce of water given through a tube. The same child who vomited 1 teaspoonful of milk or other food would retain this amount and a great deal more when the food was given by the tube. This discovery led to more extended observations. Twenty cases of persistent vomiting in all were treated in this way, of which 18 were relieved. (This series of observations was the first made relating to the use of gavage or forced feeding in persistent vomiting.<sup>1</sup>)

For the obstinate vomiting cases it is well to use gavage only once every four or six hours, with from one-third to one-half the quantity of food given in health.

The tube which is to be passed into the stomach should never be oiled, but merely dipped into the solution that is to be used. It is then passed in rapidly with the funnel empty, and the nourishment is immediately poured into the funnel. When the food has passed into the stomach, the tube should be compressed and quickly withdrawn, as some of the liquid will be retained in the tube if it is withdrawn slowly. If this is done without compressing the tube, an escape of food into the larynx may take place during the withdrawal of the tube and cause choking, coughing, and perhaps vomiting. The food selected should consist of thin dextrinized gruels, or broths and gruels combined, which have proved of great value in some cases.

In *severe illness*, such as diphtheria, pneumonia, and the grave intestinal diseases, gavage may save the life of the patient. Not infrequently in such cases insufficient nourishment is taken to support life. Rectal feeding is usually of value only for a day or two, as children soon become intolerant. In such circumstances gavage may be employed advantageously for several days at a time. In fact it is, in such an instance, the only way by which the child can be properly nourished.

Pre-digested cereal foods, completely peptonized milk, and stimulants well diluted may be given. Usually these patients badly need water. If there is no tendency to vomiting, a large quantity of water may be given with the nourishment selected, so that they may receive as much liquid as in health.

<sup>1</sup> Kerley, Gavage in Persistent Vomiting in Infants, Archives of Pediatrics, February, 1891.

*In Malnutrition, Exhaustion, and Narcosis.*—Gavage is also most useful in cases of extreme malnutrition and exhaustion, or in alcoholic or opium narcosis. Infants suffering from an extreme degree of malnutrition and exhaustion are often so reduced in strength that not enough energy remains for the taking of nourishment. In these cases gavage is distinctly a life-saving measure. To a child four months of age from 4 to 6 ounces of a suitable mixture may be given every two hours. Before the next feeding it is well to introduce a few ounces of water and withdraw it to see if the food has been properly digested. By this means of feeding there will be noticed, if the vitality is not at too low an ebb at the commencement, a daily increase in strength and vigor, which proves that the powers of assimilation persist after the desire for food or the child's ability to swallow it has been lost. This proves that we must never regard such a case as hopeless so long as the child is breathing. Time and again, after a few days' feeding in this way, the child will take the food from the bottle or spoon. Breast milk, if it can be obtained, may be given by gavage as successfully as can predigested cow's milk. The malted foods on the market have also been used temporarily with advantage, for, while deficient in nutritive value for the well, they afford sufficient nourishment for temporary use by the very ill, and are easy of digestion.

*Illustrative Case.*—A patient three months old was almost moribund as the result of extreme malnutrition. The temperature ranged from 94° to 96° F. for several days. No food could be taken. A wet-nurse was secured, but the child would not nurse. He was pale, apathetic, and too weak to cry. The wet-nurse's milk was drawn from the breast and spoon feeding attempted, but swallowing was impossible; 1½ ounces of breast milk were fed by gavage, but this proved too strong, and the child promptly vomited. The milk was then diluted one-half with weak barley water. At first 1 ounce was given at a feeding; then this was gradually increased to 2 ounces, all the feedings being retained and digested. In a week the child was able to nurse, and made a complete recovery, weighing, when seven months of age, 14 pounds. At the time gavage was commenced the weight was but 5 pounds.

## COLON IRRIGATION; COLON FLUSHING

**Colon irrigation** was brought prominently into use several years ago as a remedy in the summer intestinal disorders of young children. While unquestionably its usefulness in this respect has been overestimated and the irrigation overdone, in selected cases it is of great service. Because a child has summer diarrhea, colitis, or any disorder of the intestine, it does not follow that irrigation is indicated or that he will be benefited thereby. A child who is having a passage from the bowels every half-hour or hour is not a fit subject for irrigation. The colon is kept empty by the active peristalsis, and the washing will remove nothing more than a few shreds of mucus. The cases benefited by irrigation are those in which peristalsis is not particularly active. When a child is running a temperature of 102° F. and over, with five or six green mucous passages daily, one or two colon irrigations a day will unquestionably be of service in removing the offending material from the intestine.

Every year we see cases of intestinal infection, particularly those of a very acute type, in which there are high fever, intense prostration, and infrequent bowel action. Occasionally we see a case of this sort in which there is no movement whatever without assistance. In such cases

colon irrigation is of inestimable value, and may be used with advantage as often as once in six or eight hours. The washing, even if properly conducted, is apt to be strongly objected to by the patient and should be completed as soon as possible. Too frequent irrigation, with strong medicated solutions, may keep up the mucous discharge indefinitely. In a few cases the resistance with straining is so marked and so continuous that irrigation is impossible. These cases are usually those of children who, on account of the excessive peristalsis, do not require irrigation.

In conducting the irrigation normal salt solution at 95° F. is ordinarily used, and a quart usually suffices. If there is a great deal of mucus and blood, a 1 per cent. tannic acid solution is better. The irrigation should be continued until the solution returns clear. The temperature of the solution may be varied with advantage, depending upon the nature of the case; thus, in cases with subnormal temperature and intense prostration, cases of the so-called "algid" type, the solution at 110° F. will act as a decided stimulant. It raises the body temperature and improves the pulse and the general condition of the patient. In cases with high fever—105° to 106° F.—a cold solution answers better. A temperature as low as 70° F. has been repeatedly employed, and it has often been found that an irrigation with 4 pints of water at 70° F. will reduce the body temperature 3 degrees.

For irrigation a soft-rubber catheter, No. 18 American, is best, for the reason that its walls are stiff and the tube does not easily bend upon itself in the manner of an ordinary catheter. Should this occur, the water may escape an inch or two within the rectum, and obviously be of no service. When the tube, well lubricated, has been introduced for 9 inches, the tip will have passed into the descending colon, and further introduction will be of no advantage. When the end of the tube is in the colon gentle palpation over the left side of the abdomen will enable one readily to locate the tip. The tube is attached to an ordinary fountain-syringe by passing the distal end over the smallest rectal tip, which is a part of the outfit of every fountain-syringe. The bag should be held not over 3 feet above the child's body. When the water is allowed to run, the buttocks should be pressed together to encourage retention sufficient to insure flushing of the entire large intestine. If this can be done, the irrigation will be most efficient.

In this connection should be mentioned a particularly beneficial effect of irrigation, the absorption of a portion of the salt solution by the intestines. Not a few of the intestinal cases show a very limited food capacity. As a result of the vomiting and very frequent liquid stools the body is thoroughly drained of fluids. In such cases, after the washing is completed, we endeavor to have the child retain as much as possible of the normal salt solution. As an aid to this the child should be placed on his left side with the buttocks elevated and the tube introduced well up into the descending colon. The buttocks should be pressed together so as to assist in retaining the water after it has passed into the bowel. When a half pint or a pint has passed in, the tube should quickly be withdrawn and the child kept for half an hour in a recumbent position with the buttocks elevated. The salt solution will be best retained when it is used warm, at a temperature of from 100° to 105° F.

**Colon flushing** consists in passing into the descending colon a considerable quantity of fluid, such as normal salt solution or bicarbonate of soda solution,  $\frac{1}{2}$  ounce to 1 pint.

The measure is used with much benefit in selected cases in which but little fluid is taken by the natural channel. The possibilities of the large intestine for absorbing fluids when they are urgently needed by the organism are surprising.

*Illustrative Cases.*—A boy with cyclic vomiting who had retained absolutely nothing given by mouth for three days retained 1 pint at the first colon flushing,  $\frac{1}{2}$  pint more after six hours, and another  $\frac{1}{2}$  pint six hours later. The flushings were begun on the third day of the attack. Although the prostration was extreme, the prompt improvement in the general condition of this patient was most gratifying. After the first injection the pulse improved, the apathy disappeared, and the child began to ask questions and showed interest in his surroundings.

A boy nine years of age, ill with scarlet fever, who could take very little fluid, was able to retain 8 ounces of a salt solution given at eight-hour intervals for three days.

A child six months of age had retained absolutely nothing in the stomach for six days because of an intussusception. On the sixth day the respiration was superficial and slow. He was cold and practically pulseless. The second heart sound could be heard but faintly with the stethoscope. The intussusception very unexpectedly was reduced by water pressure (p. 280). Hot salt-water flushings were at once begun; the patient retained 12 ounces, given at a temperature of  $110^{\circ}$  F., and in a few minutes exhibited very perceptible improvement. With repeated flushings at six-hour intervals the child continued to improve and made a perfect recovery.

Severe toxic cases of diphtheria and scarlet fever, in which but little fluid is taken and in which the toxicity of the blood is extreme, as shown by the stupor and delirium, are often much improved by the free use of colon flushing, which supplies the water which the child needs, but which cannot be given by mouth, or, if given, may not be retained.

*Method.*—We usually order the salt solution given in quantities of from  $\frac{1}{2}$  to 1 pint, depending upon the age of the child, at intervals of from six to eight hours, never at a lower temperature than  $100^{\circ}$  F.

The apparatus required is a small rectal tube attached to a fountain-syringe.

The flushing is best given with the patient resting on the left side, with the buttocks elevated on a pillow, the tube, well oiled, being introduced at least 9 inches into the bowel. The solution at  $105^{\circ}$  to  $110^{\circ}$  F. is allowed to pass into the bowel, and the tube is then quickly withdrawn. To facilitate the retention of the fluid the patient should remain on his side for one-half hour.

## VACCINATION

Every infant in fair health should be vaccinated. The vaccination should be done as soon as the child is thriving on a rational diet. The younger the child at the time of vaccination, the less the constitutional disturbance. In well infants vaccination should never be delayed beyond the fifth month.

The **site** selected for the vaccination in boys is usually on the left arm, at about the point of insertion of the deltoid, and in girls on the outer aspect of the calf of the leg. It has been found, however, that it is a matter of much more convenience to the mother in dressing and handling the child if the leg is selected in both sexes. The dressing is

more easily applied to the wound and can more readily be kept in place on the leg. Further, in the manipulation necessary in dressing and undressing, much less discomfort is occasioned when the sore is on the leg.

**The Method.**—Before scarification of the skin the site selected should be well scrubbed with common soap and water, dried, and then washed with alcohol. The area of scarification should not be over  $\frac{1}{4}$  inch in diameter, and should be sufficient to produce only a light flow of serum. A deep scarification, producing a free flow of blood, is very apt to be unsuccessful. The best scarifier is an ordinary sewing needle, which should be sterilized by placing the point for a few seconds in an alcohol flame. The virus which is furnished in hermetically sealed capillary glass tubes is the safest to use. The drop of virus is to be deposited on the abraded surface and rubbed well into the wound, using the side of the needle for this purpose. When the wound is thoroughly dried, a protective dressing should be applied. The safest and most convenient is a sterile gauze bandage, which is wrapped several times around the arm or leg and secured with a safety-pin. On account of the shape and position of the parts the bandage is very apt to become displaced downward. In order to prevent this a strip of adhesive plaster 1 inch wide and 5 or 6 inches long may be placed over the bandage at right angles to it; the middle portion of the plaster readily adheres to the bandage, and the two ends, at least 2 inches long, are anchored to the skin.

**The After-treatment.**—The mother should be instructed to report seven days after the vaccination. On the seventh day the dressing may be removed, and if the vaccination is successful, the characteristic pearl-like vesicle will be present. If, on account of accident or rubbing of the parts by the patient, the vesicle is broken, the non-adhering gauze should be carefully cut away around the sore, allowing that which adheres to remain. Under no conditions should the wound be opened. Again, a gauze dressing should be applied and kept in position by adhesive strips. At the end of the exudative stage, usually about five or six days, the dressing should again be changed, either by the mother or the physician, and renewed until the crust falls, the third to the fourth week after the vaccination.

If there is no sign of the vesicle in ten or twelve days, the vaccination, if primary, should be repeated. Revaccination should be practised at least once in five years and at more frequent intervals during epidemics of smallpox.

**Constitutional Disturbance.**—A certain degree of constitutional disturbance is present in every case in which the vaccination is successful. After the first month, however, the younger the child, the less the constitutional disturbance. Children vaccinated during the second or third month suffer practically no inconvenience. There is a rise in temperature—from  $100^{\circ}$  to  $101^{\circ}$  F.—for a day or two, and when the process is at its height, perhaps a slight degree of restlessness. Repeatedly it is observed that children, vaccinated at this age, pass through the various stages without manifesting the slightest discomfort. In older children the severity of the constitutional symptoms appears to increase with the age. Thus, a child in the second or third year may have fever,  $102^{\circ}$  to  $104^{\circ}$  F., loss of appetite, coated tongue, and moderate prostra-

tion. Very active symptoms rarely last longer than three days unless there is considerable accompanying cellulitis.

**Complications.**—If vaccination is properly performed the dangers attending it are practically *nil*. That death and serious results have followed vaccination is no argument against its use, but a grave reflection on the manner in which, as a rule, it is performed. The scarification of bacteria-laden skin, producing at the outset an open wound which is indifferently or not at all protected from further infection, is very apt to produce complications of a troublesome and often serious nature. Erysipelas, extensive cellulitis, and sloughing of the parts as the result of careless vaccination are not infrequently seen. In 2 cases we have seen reinoculation as the result of scratching the sore, the virus being transferred in one case to the upper lip and in the other to the upper eyelid.

**Vaccination Shield.**—There is not a vaccination shield on the market, with which we are familiar, that is safe for use. Some cause a maceration of the wound, others allow a free entrance of bacteria, while still others prevent a free superficial circulation of the blood and increase the chance of ulceration. Moreover, the shields are very apt to become displaced, causing a rupture of the vesicle, with resulting infection.

**Local Applications.**—Active treatment, except for relief of the immediate constitutional symptoms, is rarely required. Even when there is an active cellulitis we have found it advisable not to attempt local applications, such as lotions or compresses. All ointments have a tendency to dissolve and loosen the crust, producing an open wound. When, on account of suppuration, the crust falls, leaving a deep ulcer formed by granulation tissue, active local treatment will be required. Such ulcers are often seen in out-patient work. A wet dressing of a saturated solution of boric acid has answered well in these cases. If the wet dressing cannot be kept properly applied, a 10 per cent. ointment of boric acid, applied twice a day, will be found of considerable service in hastening the closure of the wound. The ointment should be smeared freely on gauze or clean linen and held in position by a properly applied bandage. In young children the ulcers are often most obstinate. In a few instances we have known them to continue from eight to ten weeks. In cases in which the healing has been particularly slow, the familiar dressing of balsam of Peru (5 per cent.) in castor oil, applied twice daily on a pad of several thicknesses of gauze and covered with oiled silk, has appeared to hasten the granulation. Unhealthy granulations may have to be cureted or treated with silver nitrate before the dressing is applied.

## VACCINE THERAPY

**Fundamental Principles.** Vaccine therapy for prevention or cure of infection has for its object the production of an active immunity to the specific bacteria concerned, while serum therapy produces a passive immunity only.

Immunity, which is resistance or lack of susceptibility to a given disease or micro-organism, may be natural or acquired. Artificial or acquired immunity may be the result of an attack of the disease itself

or may follow inoculation with living cultures of micro-organisms in sublethal doses or in an attenuated state, with dead cultures, or with those products of the growth and metabolism of bacteria known as toxins. Immunity so acquired is active or direct, comparatively slow in appearance, and of comparatively long, though variable, duration. It is brought about by the development in the blood-serum of substances antagonistic to the vital activity of the bacteria or to the toxins. Such substances are known as antibodies. The serum of an animal which has been actively immunized and which is rich in antibodies may be inoculated into another animal for the purpose of combating infection. The immunity thus produced in the second animal is indirect or passive and of comparatively short duration.

The antibodies are of several kinds: agglutinins, opsonins, bactericidins, and lysins. They are formed by the tissue cells under the stimulus of the infecting bacteria, at first locally, then generally, and are present in the serum and to a lesser extent in the other body fluids. They manifest themselves in certain definite ways, demonstrable and measurable by laboratory methods: agglutination reaction, opsonic index, bactericidal tests, and the complement deviation test. Clinically, their increase is accompanied by amelioration of the symptoms of infection. *The aim of both vaccine and serum therapy, then, is to aid the production of antibodies in order to effect a destruction of the invading bacteria and the neutralization of their toxins.* Metchnikoff claimed that the destruction of micro-organisms is brought about by their ingestion by phagocytes, especially polymorphonuclear leukocytes. Denys and Leclef proved that there is a substance in the blood-serum which prepares the bacteria for phagocytosis. This sensitizing substance was named "opsonin" by Wright and Douglas, who elaborated methods for its study in the laboratory and for its practical application to the treatment of infections by means of vaccines made of suspensions of dead bacteria.

It has been found in general that the opsonins are below normal at the onset of an infection and during the height of the acute stage, and that, as improvement occurs, the amount of opsonin in the blood-serum increases. The administration of dead cultures of the bacteria causing the infection stimulates the production of opsonins.

**Determination of Opsonic Index.**—In order to estimate the opsonic index it is necessary to prepare serum from the patient, serum from a normal person, leukocytes from a normal person, and a culture of the bacteria from the patient's lesion.

*Serum* is readily obtained by pricking the finger and catching the blood in a small curved glass tube, as recommended by Wright. The blood is allowed to clot in the tube, and the resulting clear serum is removed by means of a capillary pipet, which is then sealed at its narrow end.

*Leukocytes* are obtained from a small quantity (about 10 drops) of normal blood caught in a tube containing 10 c.c. of 1.5 per cent. sodium citrate in normal salt solution. The mixture is centrifuged and the fluid carefully drawn off and replaced by normal salt solution, in order to wash the blood-cells free from serum. After centrifuging again the supernatant fluid is removed, and the upper layer of white blood-cells taken

up into a capillary pipet, the lower end of which is then sealed in the flame. This is known as the "leukocytic cream."

The *suspension of bacteria* is made in normal salt solution from an agar-culture not over twenty-four hours old. It should not be too thick, and should be free from clumps, which may be recovered by shaking or by manipulating with a capillary pipet.

Capillary pipets of the same caliber having been selected, equal quantities of the patient's serum, leukocytes, and bacteria are drawn up and thoroughly mixed in one, while normal serum, leukocytes, and bacteria are drawn into another. A control, using normal salt solution instead of serum, should also be made. The pipets are sealed below and incubated for fifteen minutes at 37° C. The mixture is then expelled on a glass slide, thoroughly mixed again, and spread on clean slides. After fixing in methyl-alcohol and staining in methylene-blue (Manson stain is excellent for the purpose), the slides are placed under the microscope and the number of bacteria contained within 50 leukocytes is counted. This gives the *phagocytic index*. The quotient of the patient's and the normal phagocytic indices equals the *opsonic index* of the patient. More satisfactory results have been obtained by making the tests with diluted serum, according to Neufeld. The opsonins in the normal blood-serum used for control are found to disappear in a lower dilution than do the immune opsonins in the blood of the patient who has been immunized by the disease or by the administration of vaccines. Detections from 1 : 10,000 may be made.

As a matter of fact, the test for the opsonic index has been found to be too uncertain to make it practical and worth while to follow systematically, the clinical symptoms being sufficient indication of the value of the vaccines.

**Preparation of Vaccine.**—A vaccine is made by suspending agar-cultures less than twenty-four hours old in normal salt solution. In order to estimate the dose even approximately the bacterial suspension is standardized by counting the bacteria in relation to red blood-cells. The method is as follows: Equal quantities of bacterial suspension and of blood from a normal person are drawn into a capillary pipet, mixed, and thinly spread on a slide. The red cells and the bacteria are then counted in a number of fields. Since the normal blood contains 5,000,000 red cells to the cubic millimeter, the number of bacteria in proportion to the red cells can be estimated per cubic millimeter, and the actual count per cubic centimeter readily calculated. The tube containing the bacterial suspension is sealed and heated for one hour at 58° C. Control cultures are then made to test the sterility of the undiluted suspension. This having been properly accomplished, the vaccine is diluted in bottles or ampules with sterile normal salt solution, according to the dose desired per cubic centimeter, and properly sealed. Thus, if the actual count showed that 5,000,000,000 bacteria were present in a cubic centimeter, diluting the vaccine fifty times by adding 1 c.c. of undiluted vaccine to 49 c.c. of sterile salt solution would make a vaccine containing 100,000,000 bacteria in 1 c.c. Injections of 1 c.c. or less are made into the shoulder, back, or thigh under strictest aseptic precautions.

**Staphylococcus.**—In staphylococcus infections vaccine treatment

has given good results. While it is always wise to use a vaccine prepared from the patient's own strain of staphylococcus, it is not absolutely essential that this be done. Any stock vaccine which has given good results in a similar case may be used, provided that it has been proved by a culture made from the pus of the patient's lesion that staphylococci are the infecting agents. It is essential also to know whether the *Staphylococcus aureus* or *albus* be present in order that the appropriate vaccine may be employed. The dose in infants under two years should vary from 50,000,000 to 100,000,000 of dead cocci. The inoculations are repeated on the second to the seventh day if necessary. Too rapid or too large dosage must be avoided, because there is danger of exhausting the responding power of the human organism by overstimulation. The temperature should be taken before the vaccine is injected, and every three hours during the following twenty-four.

*Furunculosis* in young infants has proved readily amenable to treatment by staphylococcus vaccines. Improvement is shown by a much more rapid healing than usual of the furuncles already incised, and by the non-appearance of new ones. After the second inoculation improvement is the rule. The amount of pus is lessened and fewer dressings are required than in cases otherwise treated. No bad effects from the injections have been noted.

In treating *otitis media* of staphylococcus origin vaccines are reported, evidently by enthusiasts, as having proved of value, also in treating *suppuration in the antrum*, *styes*, and *osteomyelitis*. After operation the vaccine has been thought of real service in aiding the more rapid disappearance of pus from the pleural cavity and in hastening the healing of the wound.

Obstinate cases of asthma unbenefited by protein therapy have also been reported as favorably affected by staphylococcus vaccine.

Any *local suppuration* due to staphylococci is occasionally benefited by vaccine administration. In *general septicemia* the results have been encouraging (Wright). Fifty million dead bacilli are to be given at the first injection; this is followed in five days by 100,000,000 and again in five days by 100,000,000. The subsequent administration is dependent upon the requirements of the case.

**Streptococcus.**—In all cases of streptococcus inflammations the results of vaccine therapy have been far less brilliant than in staphylococcus cases, but still encouraging enough to warrant their further use. It seems to be essential, also, far more than in the staphylococcus cases, that the vaccine be prepared from the strain of streptococcus infecting the patient. The dose is about 2,000,000 to 3,500,000 in babies under one year of age, 5,000,000 to 7,000,000 between one and two years, 10,000,000 to 30,000,000 in older children.

In acute infections streptococcus vaccines are generally contraindicated because the antibody production of the body is already stimulated to the maximum and the addition of bacterial toxin may result in harm.

*Erysipelas.*—According to our observation the results of vaccine therapy in this disease have been insignificant.

*Scarlet Fever.*—In scarlet fever the opsonic index to streptococci has been studied by Tunncliffe, who found that it is below the normal at the onset of the disease, but rises when the acute symptoms subside.

As local streptococcus complications appear the index falls once more. Favorable results following the injections of dead streptococci in cases of scarlet fever have not been reported.

On the other hand, this treatment of streptococcus inflammations—like *subacute* or *chronic joint affections*—has given encouraging results.

**Typhoid Bacillus.**—Inoculations of dead typhoid bacilli as a prophylactic measure against typhoid fever have been extensively employed in armies. Relatively early Russell was able to show that the incidence of disease was 6 to 15 times as high among the non-inoculated as among the inoculated soldiers. Not only are the numbers of cases far less numerous among those who have been vaccinated, but the clinical course is much less severe and much shorter, while complications are fewer. In view of these results prophylactic inoculation of children as well as of adults is to be recommended during epidemics of typhoid fever or before entering a typhoid district. Immunization is accomplished in three vaccinations, the dose of which, in children, may be 100,000,000 to 500,000,000 dead bacilli.

By lowering the incidence of typhoid fever cases antityphoid vaccination prevents the development of carriers of typhoid bacilli, and thus is fully justified.

**Gonococcus.**—In vulvovaginitis due to the gonococcus in infants under one year of age, the injections of dead gonococci have had no effect in shortening the course of the disease, in lessening the amount of discharge, nor in causing the cocci to disappear from the vagina. In older children Hamilton and Cooke found that the effect of the dead gonococcus injections is more marked in chronic than in acute cases, the disease being very decidedly shortened in its course. The later stages of the acute cases were also shortened, while no result was noted in the first weeks of the attack. Hamilton and Cooke observed no advantage from the use of a vaccine made from the patient's own organism. The initial dose of 5,000,000 was gradually increased to 40,000,000 or 50,000,000, according to the needs of the case. Injections at eight- or nine-day intervals proved best. (For personal observations see p. 520.)

**Meningococcus.**—In cerebrospinal meningitis due to the meningococcus of Weichselbaum vaccine therapy has been tried, but it has become superfluous in view of the brilliant results obtained by means of the antimeningococcus serum of Flexner and Jobling.

**Bacillus Coli Communis.**—Inoculations of dead colon bacilli in doses of 10,000,000 to 50,000,000 are reported to have given excellent results in cases of cystitis and pyelitis due to that micro-organism. The symptoms are said to subside rapidly, and the bacilli to disappear from the urine in a comparatively short time.

In a considerable trial of this method we have had no definite success.

**Tubercle Bacillus.**—Local tuberculous lesions have been treated by injections of tuberculin in very small doses, with good effect. This is true of chronic local tuberculosis without constitutional symptoms, especially in bone, joint, gland, skin, and eye affections. In pulmonary phthisis of a chronic type, running a nearly apyretic course, tuberculin is also of value. In all acute tuberculous lesions with marked fever and general symptoms tuberculin therapy has proved useless, and may be

attended by grave danger. The dose of crude tuberculin,<sup>1</sup> administered for purposes of immunization in a chronic tuberculous lesion, should be very small, 1/5000 milligram, gradually increased to 1/2000, 1/1000, or more. The inoculations should be repeated not oftener than once in ten days, at first, and the temperature carefully measured every two hours. If a rise occurs, the dose has been too large, and must be reduced at the next injection. In selected cases of bone and joint disease and also in adenitis good results have followed six or eight months of continued treatment, the dose being gradually increased in amount and the intervals shortened to three days.

**Bacillus Pertussis.**—The evidence as to the value of injections of vaccine prepared from the Bordet-Gengou bacillus of whooping-cough is still conflicting. This subject has been discussed on p. 679.

**Pneumococcus.**—There is considerable evidence to warrant the use of injections of pneumococcus vaccine for increasing resistance prophylactically against pneumonia. For curative action the serum or antibody solution is to be selected. (See p. 367.)

**Cold Vaccines.**—"Shot-gun" vaccines prepared from mixed strains of various organisms, including *Streptococcus hemolyticus*, *Streptococcus viridans*, staphylococci, *Micrococcus catarrhalis*, *Bacillus influenzae*, and the different types of pneumococcus are gaining popularity in the preventive treatment for colds. At present, however, there is little to warrant the employment of this measure. We have given such treatment in a few instances upon request, and have had favorable reports from the patients, but have obtained no evidence of the actual effectiveness of cold vaccines and cannot recommend their promiscuous use.

#### SERUM THERAPY

In most forms of serum therapy an attempt is made to confer passive immunity by the introduction into the body of an infected individual of serum from the blood of another who has a natural or acquired immunity to the existing infection.

Serum therapy is of particular value in the treatment of diphtheria, meningococcus meningitis, tetanus, and pneumonia caused by *Pneumococcus* Type I. In scarlet fever, poliomyelitis, and measles good results have been obtained either in efforts at prevention or cure, by the use of the serum of convalescent individuals with recently acquired immunity. The details of application of the method are considered in the respective chapters dealing with the diseases in which it is employed.

#### NON-SPECIFIC PROTEIN THERAPY

This form of treatment, under other names, has been employed in one form or another for many years, but only recently has received the consideration which is its due. An ancient example of its efficacy probably exists in the traditional cure of obstinate rheumatism by bee stings.

The non-specific reaction may be induced by numerous substances the action of each of which, when injected into the body, is to alter its resistance against inflammation or toxemia. In many instances this response

<sup>1</sup>Koch's old tuberculin, as prepared by the New York City Board of Health.

is at first made manifest by untoward symptoms such as increased temperature (with perhaps chill), a sudden change in the leukocyte count, and increasing malaise, the reaction being anaphylactic. In a second phase, however, leukocytosis, antibody release, and increased resistance on the part of the organism are brought into play and an abortive cure may be attained.

The non-specific reaction accounts for much of the benefit ascribed to the use of various non-specific vaccines and to the cures attributed to autoserum injections, horse-serum injections, and injections of whole blood.

Treatment of this form undoubtedly has a limited field of usefulness, but is variable in its results and at times may do much harm. The ultimate range of applicability of this method is problematic.

## XXV. DRUGS AND DRUG DOSAGE

### UNPALATABLE AND NAUSEATING DRUGS

It is impossible to mention in detail all the drugs which might be included under this heading. Only those will be referred to which we are obliged to use almost daily in our work—drugs which are either unpleasant to the taste or which may be badly borne by the stomach, or drugs combining both these disadvantages. How to administer certain drugs so that their use may be continued and yet not interfere with the digestive function is a question which deeply concerns those who may have children for their patients. The element of taste is most important to a child; therefore, when possible, drugs disagreeable to the taste should be given to children in tablet or pill form or in capsule. The continued use of a drug often depends upon its being made palatable. As a general rule, when pills, tablets, or capsules are given, one-half glass of water should be taken at the same time in order to diminish any possible irritant effects upon the mucous membrane of the stomach.

**Salicylate of soda** is a drug disagreeable in taste and very liable to destroy the appetite and interfere with digestion. In acute rheumatism its use is invaluable, and we are obliged frequently to give it in large doses. It is best given after meals with one-half glass of milk. Fairly large doses at this time, well diluted, are better than more frequent smaller doses. This drug usually is better borne if given in solution with peppermint-water or with simple elixir diluted 50 per cent. with water; but the taste when thus given is only partially disguised, and being still very objectionable to many, may be prevented by the use of a capsule if the patient is old enough, care being taken to give a considerable amount of water or milk with each capsule.

**Iodid of Potash.**—This drug is indispensable and for it no other can be substituted. It is best given in solution. It is most disagreeable in taste and directly irritant to the mucous membrane of the stomach. Like salicylate of soda, it should be given after meals with one-half to one glass of water or milk. It is best given plain, as the saturated solution, which may be dropped into the milk.

**Bichlorid of mercury** is usually given in such small doses that its irritant properties are but little felt. It is best prescribed in tablet form, dissolved in two teaspoonfuls of water and followed by a swallow of water. When possible, it should be given after feeding.

**Alcohol** is another drug which should be given well diluted, regardless of the form in which it is administered. It is best given with or after food, but should always be given diluted with at least 6 parts of water, if whisky or brandy is used.

**Ipecac and Tartar Emetic**, when employed as expectorants, are best given with sugar of milk in powder or tablet form. They should never be given on an empty stomach. Two or three teaspoonfuls of water should precede their administration when they are not given within a

reasonable time after feeding. In many children, when given without this precaution even in the usual doses, these drugs often decrease the appetite and the digestive capacity.

**The Ammonium Salts.**—Carbonate of ammonia must always be given in solution and should always be well diluted with water. Muriate of ammonia may be used in tablet or powder form. Water or milk should precede the administration of either. One part of simple elixir with 2 parts of water makes an agreeable combination.

**Oils** used for nutritive purposes should invariably be given after meals. Plain cod-liver oil or any of the preparations containing it should never be given on an empty stomach.

**Castor oil** is best given when the stomach is empty. A much more prompt and satisfactory cathartic effect is thus produced. The oil may be given in soda-water or coffee, with orange juice, or in peppermint-water. Older children sometimes take oil better plain, sandwiched between the two halves of a peppermint cream, first the candy, then the oil, followed by the remainder of the candy. If castor oil is vomited, it may be repeated in a few minutes, and often will then be retained.

**Creosote** is most difficult of administration to many children. It is customary to prescribe the carbonate, which is ordered to be dropped into 1 or 2 teaspoonfuls of wine after meals. Creosote may also be given in soft capsules or in an emulsion.

**Quinin** should be given in solution or in capsule. Quinin pills as they are sometimes made, with an insoluble coating, pass unchanged through the entire intestinal canal. For purposes of solution a most satisfactory menstruum is a preparation of yerba santa, known to the trade as Yerbazin (Lilly). Coca-quinin (Lilly) is another palatable preparation. Of the salts the bisulphate should always be prescribed for children, for the reason that it may be given in complete solution without the addition of acid.

**Strychnin**, on account of its taste, is often strenuously objected to, and is therefore better given in tablet triturate form. If the tablet cannot be swallowed, it may be broken into small pieces (not powdered) and mixed with a teaspoonful of orange pulp or in a thick cereal jelly.

**Digitalis**, in the form of the tincture or the infusion, should never be given when the stomach is empty, but should be administered after meals or the drinking of water or milk. There are few drugs that will so completely destroy a child's desire for food as the digitalis preparations when put into an empty stomach.

**Tincture of Muriate of Iron.**—This should be given after meals, well diluted, in at least one-half glass of water. The child should take the medicine through a glass tube so as not to injure the teeth. Iron preparations generally should be given after meals, and in case the liquid preparations are used, they should be well diluted withwater.

#### ALCOHOL

In its relation to children, alcohol, regardless of the form in which it is used, must always be considered as a drug and not as a beverage. It

is occasionally of great service in diseases of children and under certain conditions may answer better than any other means of stimulation we possess. The fact that it is grossly misused does not in any way detract from its value in illness. It is too often given; chiefly for the reason that its use, in the form of whisky and brandy and wine, is advocated in medical works in many of the ordinary ailments of childhood where really it is absolutely contraindicated. Its use, in our hands, has been that of a food and stimulant in very grave conditions, the duration of its usefulness being often completed in a day or two. When given to children for a prolonged period, even in moderate quantities, it invariably interferes with digestion and assimilation, and therefore does harm. It is very liable also to act as an additional irritant to the kidneys, which are prone to show inflammatory changes as a result of the systemic toxemia due to the disease. We have heart stimulants which are ordinarily as effective as alcohol and without its danger either to the stomach or the kidneys.

It is good practice never to give alcohol early in an illness unless the onset is accompanied by profound prostration, but rather to hold this drug in reserve until it is absolutely necessary. Used in this way, it has been of much service in two conditions in which nothing has been found that can replace it. We refer, first, to that time which may arise in any grave disease when the heart fails to respond to the usual stimulation, as in the crisis of lobar pneumonia and in the profound toxemia of scarlet fever or diphtheria. At such a time the powers of assimilation for most drugs as well as for food are reduced to a minimum. When food is rejected or taken badly, when the usefulness of strychnin, strophanthus, musk, camphor, digitalis, and caffein has been exhausted, alcohol should be given and given in as large doses as may be required to produce the desired results. It is astonishing what large quantities of alcohol may be given in many such conditions without the slightest intoxicating effects. When given well diluted it is usually well borne and assimilated; it supports the heart, improves the respiration, and often will carry the patient through to a successful convalescence even when the outlook is very unpromising. As the system readily becomes accustomed to alcohol, it must be given in increasing doses. If it is given early in the illness, it will have lost its stimulating effects by the time it is most needed. Brandy and whisky, well diluted, are the forms in which it is generally used.

The second condition in which alcohol is useful is in cases with greatly lowered vitality resulting from some severe illness, such as typhoid fever, enterocolitis, or pneumonia. If a child is suffering from shock bordering on collapse, or collapse with a subnormal temperature with all the vital powers at a low ebb, alcohol will do much to sustain him until he is able to assimilate easily digested or predigested foods. In such cases whisky, well diluted—1 part whisky to 6 parts of water—given at intervals of two or three hours, will hasten recovery. If the child cannot swallow, the whisky may be given by gavage; if it is vomited, a double quantity, well diluted, may be given by the rectum. The hypodermic use of alcohol is infrequently resorted to chiefly for the reason that other remedies, such as strychnin and digitalis, are more effective than alcohol when so given. The doses vary from 5 drops to  $\frac{1}{2}$  dram every one or two hours, twelve to twenty-four doses in twenty-four hours, for a child one year of age. A

child two years of age may be given 1 dram at intervals of one or two hours. The use of alcohol is attended with the least disturbance when it is given after the feedings.

### ANESTHETICS

That the administration of anesthetics to children is attended with considerable danger is proved by statistics relating to the subject, and that the greatest care and judgment should be exercised in the selection of an anesthetic for a child is readily understood.

*Ether and Chloroform.*—As a routine anesthetic for the young, ether is preferable because of its safety. The popular belief that chloroform is without danger is in error and not sustained by statistics. There are conditions, however, when ether is contraindicated. In cases in which there is bronchial involvement, ether increases the bronchial secretions and produces a free flow of saliva, which is liable to be aspirated into the lungs. In case of any obstruction to respiration, from laryngeal diphtheria, retropharyngeal abscess, or enlarged glands which may encroach upon the air-passages, chloroform, and not ether, should be employed. Ether is further contraindicated in scarlet fever or in nephritis. In such cases chloroform is to be selected. Chloroform is to be used also for the sake of convenience, if other conditions allow, in minor operations about the mouth and the nose. Chloroform is contraindicated in general weakness, exhaustion, collapse, and in anemia. Ether given by the drop method should be used in these cases. Statistics of chloroform anesthesia show a considerable mortality in operations for adenoids and enlarged tonsils. The interference with respiration and the sudden hemorrhage make chloroform dangerous in these operations. In heart disease with imperfect compensation any anesthetic is dangerous, but ether, by the drop method is the least dangerous.

*Nitrous oxid gas*, which of late has become very popular, should be given with caution to children under two years of age. Young children are very easily asphyxiated by gas; the younger the child, the greater the danger. Gas should be used, therefore, very sparingly and the patient watched most carefully for signs of cyanosis. The use of gas for children frequently precedes the administration of ether, as this practice renders the latter much less disagreeable to the patient. Such procedure is contraindicated, however, in any condition where dyspnea is present; in fact, in any illness in which respiration is impeded, gas is dangerous. The combination of gas and ether in such cases is not as safe as chloroform, which is to be given in a minimum amount with oxygen as a safeguard.

*Nitrous Oxid Gas with Oxygen.*—The admixture of oxygen renders possible prolonged administration of nitrous oxid without the risk attendant upon its use alone. This form of anesthesia has become very popular in recent years because of freedom from unpleasant after-effects. The method, however, calls for special apparatus of some complexity and imposes upon the anesthetist close watchfulness of the variations in degree of unconsciousness of the patient. To secure adequate general relaxation ether as a supplement must often be employed. The method is not without the dangers attendant upon ordinary gas administration, but in expert hands may be employed with safety and obvious advantage.

*Danger-signals with Ether:*

Marked cyanosis; stertorous breathing; rapid pulse; dilated pupils; short, quick, gasping respiration.

*Danger-signals with Chloroform:*

Pallor; ashen color; feeble, shallow respirations, gasping in character; dilated pupils and separation of the eyelids; slow feeble heart action.

*Danger-signals during Gas Administration:*

Cyanosis; jerking respirations; dilated pupils; convulsive movements of any portion of the body.

*Ethyl Chlorid.*—The use of ethyl chlorid is in the experimental stage. Statistics show quite a mortality from its use. It should not be continuously administered after unconsciousness has set in. In case any of the danger-signals are observed the ethyl chlorid should temporarily or permanently be discontinued and some other form of anesthetic substituted.

# DRUGS FOR INTERNAL USE

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
ACETANILID. Not advised in the treatment of children.				
ACID, ARSENIOS. See <i>Arsenic</i> .				
ACID, BENZOIC. Benzoic acid; flowers of benzoin. Used in cystitis of alkaline type. ....	1 gr.	1-2 gr.	2 gr.	3-5 gr.
ACID, GALLIC. <i>Bismuth subgallate</i> . (Dermatol.) Used internally as an intestinal astringent, also externally. ....	3-5 gr.	5 gr.	10 gr.	10 gr.
ACID, HYDROCHLORIC, DILUTE. (Corresponding to 31.9 per cent. of absolute HCl.) Used in chronic gastritis with atony of the stomach. ....	$\frac{1}{4}$ - $\frac{1}{2}$ drop	1 drop	2 drops	3-5 drops
ACID, LACTIC. Used in fermentative diarrheas. Given best well diluted with syrup and water or in milk. (See p. 88.) ....	..	1 drop	2 drops	3-5 drops
ACID, PHOSPHORIC, DILUTE. (Containing 10 per cent. orthophosphoric acid.) Used as a stomachic. ....	1-2 drops	2-3 drops	5 drops	10 drops
ACID, SALICYLIC. Seldom used uncombined. <i>Bismuth subsalicylate</i> . Intestinal astringent and sedative ....	1 gr.	1-2 gr.	2 gr.	3-5 gr.
<i>Methyl salicylate</i> . (Synthetic oil of wintergreen.) Antirheumatic. ....	1 drop	2-3 drops	3 drops	3-5 drops
<i>Oil of Wintergreen</i> . (Natural.) Antirheumatic. ....	1 drop	2-3 drops	3 drops	3-5 drops
<i>Salol</i> . (Phenyl salicylate.) Intestinal antiseptic and antirheumatic	$\frac{1}{2}$ gr.	1-2 gr.	2 gr.	3 gr.
<i>Sodium salicylate</i> . Antirheumatic. ....	1 gr.	1-2 gr.	2-3 gr.	3-5 gr.
<i>Aspirin</i> . (Non-official.) (Acetyl-salicylic acid.) Antirheumatic—a substitute for sodium salicylate, at times better tolerated by the stomach. Best given in capsules, for it is decomposed by alkalis and by moisture. ....	1 gr.	1-2 gr.	2 3 gr.	3-5 gr.
ACID, TANNIC. Used in the form of: <i>Tannalbin</i> . (Dried albuminate of tannin.) Used as an intestinal astringent. ....	1-2 gr.	1-2 gr.	2-3 gr.	3-5 gr.
<i>Tannigen</i> . (Acetyl-tannin.) Used as an intestinal astringent. .... Also by rectum: 1 per cent. solution of tannic acid in an enema, for dysentery or colitis.	1-2 gr.	1-2 gr.	2-3 gr.	3-5 gr.

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
ACID, TARTARIC. Seldom used except as one of its salts. <i>Potassium bitartrate.</i> (Cream of tartar.) Diuretic, refrigerant, and aperient. Used as an ingredient of diuretic drinks. To one pint of water to be drunk in twenty-four hours is added. ....	..	2 dr.	..	4 dr.
<i>Potassium and antimony tartrate.</i> (Tartar emetic.) Used as an expectorant. Its action is too violent for use as an emetic. Best given alone or with ipecac in a tablet or in a mixture with a simple elixir. May cause severe gastro-enteritis in too large doses. ....	$\frac{1}{2}$ gr.	$\frac{1}{16}$ gr.	$\frac{1}{16}$ gr.	$\frac{1}{16}$ gr.
<i>Potassium and sodium tartrate.</i> (Rochelle salt.) Laxative. ....	15 gr.	30 gr.	1-2 dr.	3-4 dr.
ACONITE. ( <i>Aconitum napellus.</i> ) (Root contains 0.5 per cent. aconitin.) <i>Tincture of aconite root</i> (10 per cent.) Used in a beginning fever as a circulatory sedative and an analgesic. ....	$\frac{1}{2}$ drop	$\frac{1}{4}$ drop	1 drop	1-2 drops
ADRENALIN. (1:1000 solution.) See p. 882. Ineffective by mouth. Intramuscularly and intravenously a vasoconstrictor and bronchodilator. Circulatory stimulant and antiasthmatic. ....	1 drop	2 drops	3 drops	3 drops
ALCOHOL. (Ethyl alcohol, spirits of wine.) General stimulant toward the end of an illness or as a last resort. (See p. 867.) <i>Brandy.</i> ( <i>Spiritus vini gallici</i> , containing 39-47 per cent. alcohol by weight.)..	5-10 drops	10-20 drops	20-30 drops	30-40 drops
<i>Whisky.</i> ( <i>Spiritus frumenti</i> , containing 44-50 per cent. alcohol by weight.)..	5-10 drops	10-20 drops	20-30 drops	30-40 drops
<i>Sherry wine.</i> ( <i>Vinum xerici</i> , containing alcohol, 15-20 per cent. by weight.)..	..	30 drops	45 drops-1 dr.	1-2 dr.
ALOES. Not advised for children.				
ALUM. Not advised for children.				
AMMONIUM. <i>Ammonium bromid.</i> See <i>Bromin.</i> <i>Ammonium chlorid.</i> (Sal ammoniac.) Stimulating expectorant; best given dissolved in half an ounce of water. ....	$\frac{1}{4}$ gr.	$\frac{1}{4}$ $\frac{1}{2}$ gr.	1 gr.	1-2 gr.
<i>Ammonium carbonate.</i> (Sal volatile.) Stimulating expectorant; best given dissolved in half an ounce of water. ....	$\frac{1}{4}$ - $\frac{1}{2}$ gr.	$\frac{1}{2}$ -1 gr.	1 gr.	1-2 gr.
<i>Solution of ammonium acetate.</i> ( <i>Liquor ammonii acetatis</i> or spirits of <i>Mindererus.</i> ) Stimulating expectorant; best given well diluted in carbonic water. Used also as a diuretic, antipyretic, and diaphoretic. ....	..	$\frac{1}{2}$ -1 dr.	1 dr.	2 dr.
<i>Aromatic spirits of ammonia.</i> ( <i>Spiritus ammonii aromaticus.</i> ) Used as a stimulating expectorant, volatile stimulant, carminative, and antispasmodic. Best given well diluted with water. ....	3 drops	3-5 drops	5 drops	5-10 drops

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
ANTIMONY. <i>Antimony and potassium tartrate.</i> (Tartar emetic.) See under <i>Acid, Tartaric.</i>				
ANTIPYRIN. Analgesic and sedative in pertussis and laryngitis. Best given alone in powder form, or with sodium bromid in solution. ....	$\frac{1}{2}$ gr.	1-1 $\frac{1}{2}$ gr.	2 gr.	3 gr.
ANTITOXIN. See <i>Serum, Antidiphtheric.</i>				
APOMORPHIN. Not advised in the treatment of children.				
ARSENIC. <i>Arsenious acid.</i> (Arsenic trioxid or white arsenic.) Used in anemia, malaria, and chorea. Administere either in solution (see Fowler's solution) or in tablets with other ingredients. In large doses it is an irritant poison, causing puffiness of the eyes and gastroenteritis, both of which are signs of an overdose. Cannot be given with astringents, tinctures, or decoctions or with solutions of iron. Antidotes are hydrated iron with magnesia, egg-albumen, and emetics. Given three times a day. .... <i>Fowler's solution.</i> (Liquor potassii arsenitis.) Uses, action, and antidotes are the same as those of arsenious acid. Best given in water into which it is freshly dropped. ....	..	2 $\frac{1}{10}$ gr.	1 $\frac{1}{10}$ gr.	1 $\frac{1}{10}$ gr.
ASAFETIDA. <i>Emulsion of asafetida.</i> (Milk of asafetida.) Used chiefly as an ingredient of enemas, especially in excessive tympanites. To 8 ounces of diluent. ....	$\frac{1}{2}$ drop	1 drop	2 drops	2-5 drops
ASPIDIUM. (Male-fern.) <i>Oleoresin of male-fern.</i> Teniafuge. Best given in emulsion or in capsules. .	..	1 dr.	1 dr.	1 dr.
ASPIRIN. See under <i>Acid, Salicylic.</i>				
ATROPIN. See under <i>Belladonna.</i>				
BASHAM'S MIXTURE. See under <i>Iron.</i>				
BELLADONNA. (From the leaves of the <i>Atropa belladonna</i> , containing 0.35 per cent. of alkaloid.) <i>Atropin.</i> (Alkaloid of belladonna.) Respiratory stimulant, anidrotic. Used as a stimulant, a mydriatic, and for the cure of enuresis. .... <i>Tincture of belladonna</i> (10 per cent. leaves). Uses similar to those of atropin. .... <i>Belladonna leaves.</i> (Asthma powder.) Used occasionally with the leaves of conium and stramonium, and potassium nitrate (saltpeter) to relieve attacks of asthma. To be burned in a metallic receptacle.	5 $\frac{1}{100}$ gr.	3 $\frac{1}{100}$ gr.	2 $\frac{1}{100}$ gr.	2 $\frac{1}{100}$ gr.
	$\frac{1}{4}$ - $\frac{1}{2}$ drop	1 drop	1-2 drops	3-5 drops

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
BENZOIC ACID. See <i>Acid, Benzoic</i> .				
BENZYL BENZOATE.				
Antispasmodic in croup, asthma, pertussis, and colic administered in form of a 20 per cent. alcoholic solution.....	10 drops	15 drops	20 drops	25-30 drops
BICHLORID OF MERCURY. See under <i>Mercury</i>				
BISMUTH.				
<i>Bismuth subcarbonate</i> .				
Intestinal astringent and sedative.....	10 gr.	10 gr.	10 gr.	20 gr.
<i>Bismuth subgallate</i> . (Dermatol.)				
Intestinal astringent and sedative.				
Used also externally.....	3-5 gr.	5 gr.	5-10 gr.	10 gr.
<i>Bismuth subnitrate</i> .				
Intestinal astringent and sedative.....	5-10 gr.	10 gr.	10-15 gr.	20 gr.
<i>Bismuth subsalicylate</i> . See under <i>Acid, Salicylic</i> .				
BLAUD'S PILL. See under <i>Iron</i> .				
BORAX. (Sodium borate.) See under <i>Sodium</i> .				
BRANDY. See under <i>Alcohol</i> .				
BROMIN.				
Used only in the form of its salts.				
<i>Ammonium bromid</i> .				
Sedative. Used in laryngismus, pertussis, asthmatic bronchitis, and sleeplessness.				
Best given well diluted with water....	1-3 gr.	2-4 gr.	3-5 gr.	5-8 gr.
<i>Potassium bromid</i> .				
Used same as the ammonium salt, but is more depressing.....	1-3 gr.	2-4 gr.	3-5 gr.	5-8 gr.
<i>Sodium bromid</i> .				
Used same as the above. It is midway between the ammonium and the potassium salts in its depressant action.....	1-3 gr.	2-4 gr.	3-5 gr.	5-8 gr.
<i>Strontium bromid</i> .				
Used same as the above.....	1-3 gr.	2-4 gr.	3-5 gr.	5-8 gr.
BROWN MIXTURE. See under <i>Licorice</i> .				
CAFFEIN.				
<i>Caffein sodiosalicylas</i> (60 per cent. caffein)	$\frac{1}{2}$ gr.	$\frac{1}{2}$ -1 gr.	1-1 $\frac{1}{2}$ gr.	1 $\frac{1}{2}$ -2 gr.
<i>Caffein sodiobenzoas</i> (50 per cent. caffein)	$\frac{1}{2}$ gr.	$\frac{1}{2}$ -1 gr.	1-1 $\frac{1}{2}$ gr.	1 $\frac{1}{2}$ -2 gr.
<i>Citrate of caffein</i> (50 per cent. caffein).				
General stimulant and diuretic.....	$\frac{1}{2}$ gr.	$\frac{1}{2}$ -1 gr.	1 gr.	1-2 gr.
CALCIUM.				
<i>Calcium bromid</i> .				
Indicated in convulsive disorders, including tetanus neonatorum.....	2 gr.	3 gr.	5 gr.	5 gr.
Particularly indicated in tetany in which the 3 per cent. solution may be employed hypodermically				
Of possible benefit in hemophilia and milder forms of purpura.....	$\frac{1}{2}$ gr.	1 gr.	1-2 gr.	2 gr.
<i>Calcium lactate</i> .....	5 gr.	10 gr.	20 gr.	20 gr.
<i>Calcium sulphid</i> .				
Antipustulant.....	$\frac{1}{30}$ gr.	$\frac{1}{20}$ gr.	$\frac{1}{20}$ gr.	$\frac{1}{10}$ gr.
Prepared chalk.				
Antacid.....	2 gr.	3 gr.	5 gr.	5-8 gr.
<i>Compound chalk mixture</i> . (Mistura cretæ composita.)				
20 per cent. chalk powder, 40 per cent. cinnamon-water.				
Antacid. Every two hours.....	1 dr.	1 dr.	1 $\frac{1}{2}$ dr.	2 dr.
CALOMEL. See under <i>Mercury</i> .				

DRUG.	Dose.			
	6 Months.	18 Months.	3 Years.	5 Years.
<b>CAMPHOR.</b>				
<i>Powdered camphor.</i>				
Used in coryza. Every two hours....	$\frac{1}{10}$ gr.	$\frac{1}{5}$ gr.	$\frac{1}{4}$ gr.	$\frac{1}{4}$ gr.
<i>Spirits of camphor</i> (10 per cent. in alcohol).				
Stimulant, anodyne, carminative.....	3 drops	5 drops	5-10 drops	10 drops
<i>Water of camphor.</i> (Aqua camphoræ.)				
(Contains 0.8 per cent. of camphor.)				
Used as a vehicle.				
<b>CANTHARIDES.</b>				
Used best in:				
<i>Tincture of cantharides</i> (10 per cent.)				
Useful in cystitis and functional albuminuria .....	..	..	$\frac{1}{4}$ - $\frac{1}{2}$ drop	$\frac{1}{2}$ drop
<b>CAPSICUM.</b>				
Used best in:				
<i>Tincture of capsicum</i> (10 per cent.).				
Used as a carminative and stomachic.				
Best given well diluted in water.....	..	1 drop	2-3 drops	3-5 drops
<b>CARDAMOM.</b>				
Used best as:				
<i>Tincture of cardamom.</i>				
Used as a carminative	5 drops	10 drops	15 drops	20 drops
<b>CASCARA SAGRADA.</b> (Bark of <i>Rhamnus purshiana</i> .)				
<i>Extract of cascara sagrada.</i>				
(Four times the strength of the bark.)				
Tonic laxative .....	..	$\frac{1}{2}$ gr.	1-2 gr.	3-5 gr.
<i>Fluidextract of cascara sagrada.</i> (Aromatic.) (1 c.c. = 1 gm. bark.)				
The active principles are retained, but the bitter principles are eliminated.				
Tonic laxative .....	15 drops	30-45 drops	1 dr.	1-2 dr.
<b>CASTOR OIL.</b> ( <i>Oleum ricini</i> .)				
(Expressed from the seeds of <i>Ricinus communis</i> .)				
Bland oil and cathartic.				
Given usually for one dose.....	1 dr.	2 dr.	3 dr.	4 dr.
<b>CERIUM OXALATE.</b>				
Sedative in vomiting.....	2 gr.	2-3 gr.	3 gr.	3-5 gr.
<b>CHALK.</b> See <i>Calcium</i> .				
<b>CHLORAL HYDRATE.</b>				
Sedative, hypnotic, and antispasmodic.				
Best given in some bland fluid by rectum .....	..	1 gr.	$1\frac{1}{2}$ gr.	2 gr.
<b>CHLOROFORM.</b>				
Given internally as:				
<i>Spirits of chloroform.</i> (Chloric ether.) (6 per cent, chloroform.)				
Carminative, antispasmodic, and sedative.....	2-3 drops	3-5 drops	5-15 drops	15-20 drops
<i>Water of chloroform.</i> (Aqua chloroformi.) (0.5 per cent chloroform.)				
Vehicle and carminative.....	$\frac{1}{2}$ dr.	$\frac{1}{2}$ -2 dr.	2-3 dr.	4 dr.
<b>CINCHONA.</b> See under <i>Quinin</i> .				
<b>COCAIN, or:</b>				
<i>Cocain Hydrochlorid.</i>				
Local anesthetic by hypodermic injection. Not as safe as Novocain <i>q. v.</i>				
Used in 0.2 per cent. to 2 per cent. strength. But seldom used for local anesthesia in children. Used by the mouth in obstinate vomiting.....		$\frac{1}{100}$ gr.	$\frac{1}{50}$ gr.	$\frac{1}{25}$ gr.

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
CODEIN. See <i>Opium</i> .				
COD-LIVER OIL. ( <i>Oleum morrhuæ</i> .) Fixed oil from fresh cod's livers. Alterative and tonic particularly valuable in promoting calcium retention. Indicated in rickets and spasmophilia and to be given prophylactically to well infants. Given three times a day. ....	10-15 drops	15-20 drops	20-30 drops	$\frac{1}{2}$ -1 dr.
CORROSIVE SUBLIMATE. See <i>Corrosive Chlorid of Mercury</i> .				
CREAM OF TARTAR. See under <i>Acid, Tartaric</i> .				
CREOSOTE. ( <i>Beechwood creosote</i> .) Tonic, alterative, and antitubercular. Best given in an emulsion with cinnamon-water, three times a day after meals. ....	$\frac{1}{2}$ drop	2 drops	2-3 drops	3-5 drops
<i>Cresotal</i> . (Carbonate of creosote—92 per cent. creosote.) Is preferable to creosote because it has little odor, a more agreeable taste, and is better borne by the stomach. ....	$\frac{1}{2}$ drop	2 drops	2-3 drops	3-5 drops
DERMATOL. ( <i>Bismuth subgallate</i> .) See under <i>Bismuth</i> .				
DIGITALIS. (From the leaves of <i>Digitalis purpurea</i> .) Heart stimulant and tonic; also diuretic. Best given by mouth in the form of the tincture and hypodermically either as the tincture or as digitalin. <i>Tincture of digitalis</i> (10 per cent. leaves) .. <i>Infusion of digitalis</i> (66 gm.=1 gm. leaves) .. <i>Digitalin</i> (10 times strength of leaves) ..	$\frac{1}{2}$ drop .. 200 gr.	1 drop .. 200 gr.	1-2 drops $\frac{1}{2}$ -1 dr. 100 gr.	2-3 drops 1-3 dr. 100 gr.
DIPHTHERIA ANTITOXIN. See <i>Serum, Antidiphtheric</i> .				
DIURETIN. ( <i>Theobromin sodiosalicylate</i> .) Diuretic in cardiac dropsy and hydrocephalus .....	1 gr.	1½ gr.	2 gr.	3 gr.
DOVER'S POWDER. See under <i>Opium</i> .				
EPSOM SALT. See under <i>Magnesium</i> .				
ERGOT. Hemostatic, circulatory stimulant. <i>Fluidextract of ergot</i> (1 c.c.=1 gm. ergot)	2-3 drops	5 drops	5-8 drops	10-15 drops
ERODICTYON. See <i>Yerba Santa</i> .				
ETHER. Used internally as: <i>Compound spirits of ether</i> . (Hoffmann's anodyne, 32.5 per cent. ether.) Anodyne, carminative, antispasmodic, and stimulant. Best given well diluted with water. .... <i>Spirits of nitrous ether</i> . (Sweet spirit of niter, 4 per cent. ethyl nitrite.) Used as a diaphoretic, diuretic, and carminative. It is volatile and explosive and incompatible with many drugs. Best given alone or in a simple elixir. ....	2 drops	3-5 drops	5 drops	5-10 drops
FEL BOVIS. See <i>Ox-gall</i> .	2-3 drops	3-5 drops	5 drops	5-10 drops.
FERRUM. See <i>Iron</i> .				
FOWLER'S SOLUTION. See <i>Arsenic</i> .				

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
GALLIC ACID. See <i>Acid, Gallic</i> .				
GENTIAN. <i>Extract of gentian.</i> Stomachic and bitter tonic. Given three times a day.....	..	..	$\frac{1}{4}$ – $\frac{1}{2}$ gr.	$\frac{1}{2}$ –1 gr.
GLAUBER'S SALT. (Sodium sulphate.) See under <i>Sodium</i> .				
GLONIN. See <i>Nitroglycerin</i> .				
GLYCERIN. Used chiefly as a demulcent base and a vehicle for other drugs.				
GLYCYRRHIZA. See <i>Licorice</i> .				
HEXAMETHYLENAMIN. Official name for the proprietary <i>urotropin, q. v.</i>				
HOFFMANN'S ANODYNE. See under <i>Ether</i> .				
HYDRARGYRUM. See <i>Mercury</i> .				
HYOSCYAMUS. (Of belladonna group.) Sedative and antispasmodic. Not advised for children.				
IPECAC..... <i>Syrup of ipecac</i> .....	$\frac{1}{100}$ gr. $\frac{1}{2}$ –1 drop	$\frac{1}{8}$ gr. 1–2 drops	$\frac{1}{60}$ gr. 3 drops	$\frac{1}{60}$ gr. 3–5 drops
IRON. Given every two hours. <i>Liquor ferri et ammonii acetatis.</i> (Basham's mixture—solution of iron and ammonium acetate—10 per cent. metallic iron)..... <i>Ovoferrin</i> . (Proprietary organic iron.)... <i>Pyrophosphate of iron</i> (10 per cent. of metallic iron)..... <i>Syrup of the iodid of iron</i> (5 per cent. ferrous iodid)..... <i>Tincture of the chlorid of iron.</i> (35 per cent. of ferric chlorid and must be at least one year old.).....	.. 5 drops .. 3 drops 1 drop	.. 10 drops .. 6 drops 3 drops	$\frac{1}{2}$ dr. 15–20 drops 1–2 gr. 10 drops 5 drops	1 dr. 20–30 drops 2–3 gr. 20–30 drops 10–15 drops
JALAP. <i>Powdered jalap.</i> (Contains 8 per cent. resin.) Hydragogue cathartic and diuretic.....	..	..	2 gr.	3 gr.
LACTIC ACID. See <i>Acid, Lactic</i> .				
LICORICE. <i>Compound licorice mixture.</i> (Brown mixture—12 per cent. paregoric.) Sedative expectorant mixture. Given at two-hour intervals..... <i>Compound licorice powder.</i> Laxative.....	15 drops 10 gr.	20 drops 10–20 gr.	30–40 drops 30 gr.	40 drops –1 dr. 40 gr.–1 dr.
MAGNESIUM. <i>Magnesium carbonate.</i> Antacid and laxative..... <i>Magnesium citrate, solution of.</i> (Liquor magnesii citratis.) Laxative. For one dose..... <i>Magnesium oxid.</i> (Calcined magnesia.) Antacid and laxative..... <i>Magnesium sulphate.</i> (Epsom salt.) Laxative. To be given every two hours and discontinued when the desired effect has been produced.....	5–10 gr. .. 5–10 gr. 10–15 gr.	20 gr. .. 10–20 gr. 20 gr.	30–40 gr. 2 oz. 20–30 gr. 20–30 gr.	40 gr.–1 dr. 2–4 oz. 30–40 gr. $\frac{1}{2}$ –1 dr.
MALE-FERN. See <i>Aspidium</i> .				
MENTHA PIPERITA. See <i>Peppermint</i> .				
MENTHA VIRIDIS. See <i>Spearmint</i> .				

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
MERCURY.				
Mass of mercury. (Blue mass—35 per cent. mercury.)				
Cathartic and antisyphilitic.				
Used once a day.	..	..	1 gr.	1-2 gr.
Corrosive chlorid of mercury. (Bichlorid of mercury or corrosive sublimate.)				
Antisyphilitic.				
Given three times a day.	$\frac{2}{100}$ gr.	$\frac{1}{100}$ gr.	$\frac{1}{100}$ gr.	$\frac{7}{5}$ gr.
Mild chlorid of mercury. (Calomel.)				
Cathartic, cholagogue, antisyphilitic.				
At ten-minute intervals.	$\frac{1}{10}$ gr.	$\frac{1}{6}$ gr.	..	..
At half-hour intervals.	..	..	$\frac{1}{4}$ gr.	$\frac{1}{4}$ gr.
Rarely necessary to give more than one grain for laxative effect.				
Red iodid of mercury. (Biniodid.)				
Antisyphilitic.				
Given three times a day.	$\frac{1}{150}$ gr.	$\frac{1}{100}$ gr.	$\frac{5}{50}$ gr.	$\frac{2}{5}$ — $\frac{1}{10}$ gr.
Mercury with chalk. (Gray powder.) (38 per cent. mercury.)				
Intestinal antiseptic, cholagogue, and antisyphilitic.				
At one-hour intervals—total 1 gr.	$\frac{1}{4}$ gr.	$\frac{1}{4}$ gr.	..	..
At one-hour intervals—total 2 gr.	..	..	$\frac{1}{2}$ gr.	$\frac{1}{2}$ gr.
METHYL SALICYLATE. See under <i>Acid, Salicylic</i> .				
MINDERERUS, SPIRITS OF. See under <i>Ammonium</i> .				
MORPHIN. See under <i>Opium</i> .				
MYRRH.				
Tincture of myrrh (20 per cent.).				
Used as a mouth-wash diluted with water.				
NITER. See under <i>Ether, Sweet Spirits of Niter</i> .				
NITROGLYCERIN. (Glonoin, glyceryl trinitrate.)				
Vasodilator.	$\frac{4}{100}$ gr.	$\frac{3}{100}$ gr.	$\frac{2}{100}$ gr.	$\frac{1}{100}$ gr.
Spirits of glyceryl trinitrate, or spirits of glonoin, old U. S. P. (1 per cent. alcoholic solution).	$\frac{1}{4}$ drop	$\frac{1}{3}$ drop	$\frac{1}{2}$ drop	1 drop
NOVOCAIN. Action and uses similar to those of cocain, but toxicity much less than that of cocain. Novocain is not readily absorbed by mucous membranes or the eye, for which reason it must be used hypodermically. Usual strength employed is 1 per cent.				
NUX VOMICA. (From <i>Strychnos nux-vomica</i> .)				
Tincture of nux vomica (1 per cent. strychnin.)				
Stomachic and stimulant.	$\frac{1}{2}$ drop	1 drop	1-2 drops	2-4 drops
Strychnin. (Alkaloid of nux vomica.)				
General stimulant, well borne by children.				
Every two or three hours.	$\frac{4}{100}$ — $\frac{2}{100}$	$\frac{1}{100}$ gr.	$\frac{1}{100}$ gr.	$\frac{1}{100}$ gr.
OLEUM GAULTHERIUM. (Oil of winter-green.) See under <i>Acid, Salicylic</i> .				
OLEUM MORRHUÆ. See <i>Cod-liver Oil</i> .				
OLEUM OLIVÆ. See <i>Olive Oil</i> .				
OLEUM RICINI. See <i>Castor Oil</i> .				

Drug.	Dose.			
	6 Months.	18 Months.	3 Years.	5 Years.
OLIVE OIL.				
Laxative and nutrient.	15 drops	15-30 drops	30 drops	1 dr.
Used at night by rectum for the cure of constipation.	1 oz.	1½ oz.	2 oz.	3 oz.
OPIMUM.				
Sedative, anodyne, hypnotic.				
<i>Tincture of deodorized opium</i> (10 per cent.)				
Used in 3 to 10 drop doses in enemata as a sedative for children under five years of age.				
<i>Camphorated tincture of opium</i> . (Paregoric—0.4 per cent. opium.)				
Sedative and analgesic.	3-5 drops	10 drops	15-20 drops	20-30 drops
<i>Powder of ipecac and opium</i> . (Dover's powder—10 per cent. each of ipecac and opium.)				
Sedative.	⅛-¼ gr.	⅓-¾ gr.	1-1½ gr.	2-3 gr.
<i>Morphin</i> . (Alkaloid of opium.)				
Not well borne by children and best given hypodermically.	⅓ gr.	⅓ gr.	⅓ gr.	⅓ gr.
<i>Codein</i> . (Menthylmorphin.)				
As sulphate or phosphate.	..	⅓ gr.	⅓ gr.	⅓ gr.
<i>Heroin</i> . (Diacetylmorphin.)				
As hydrochlorid.	..	⅓ gr.	⅓ gr.	⅓ gr.
Depressant. Codein is preferable	..	⅓ gr.	⅓ gr.	⅓ gr.
ORANGE-JUICE. ( <i>Citrus aurantium</i> .)				
Antiscorbutic.	½ oz.	..	..	1 oz.
OX-GALL. ( <i>Fel bovis</i> —fresh ox-bile.)				
Used as a laxative in enemata—½-1 dr. to a pint of water.				
PAREGORIC. <i>Camphorated tincture of opium</i> .				
See under <i>Opium</i> .				
PEPO. See <i>Pumpkin Seed</i> .				
PEPPERMINT.				
<i>Aqua menthæ piperitæ</i> —Peppermint water. (0.2 per cent. oil of peppermint.)				
Carminative, sedative, corrective, and vehicle.	1 dr.	1-2 dr.	3 dr.	4 dr.
PEPSIN.				
<i>Powdered pepsin</i>	1 gr.	1-2 gr.	2-3 gr.	3 gr.
<i>Essence of pepsin</i>	20 drops	30-40 drops	40 drops -1 dr.	1 dr.
PHENACETIN. ( <i>Acetphenetidin</i> .)				
Antipyretic and analgesic.	½ gr.	1 gr.	1½ gr.	2 gr.
PHENOLPHTHALEIN				
Mild, non-gripping, laxative.	..	1 gr.	1½ gr.	2 gr.
PHOSPHORIC ACID. See <i>Acid, Phosphoric</i> .				
PHOSPHORUS.				
<i>Oleum phosphoratum</i> (1 per cent. in almond oil).				
Alterative.	½ drop	1 drop	1½ drops	2-4 drops
<i>Syrup of hypophosphites</i> .				
(Calcium, 4.5 per cent.; sodium and potassium, each, 1.5 per cent.)	½ dr.	¾ dr.	1 dr.	1-2 dr.
PILOCARPIN.				
Not advised for children.				
POTASSIUM.				
<i>Potassium acetate</i> .				
Diuretic, refrigerant, and alterative.	1-2 gr.	2-3 gr.	3 gr.	5 gr.
<i>Potassium bicarbonate</i> .				
Should not be given to children on account of its disagreeable taste.				

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
POTASSIUM ( <i>Continued</i> ).				
<i>Potassium bitartrate</i> . (Cream of tartar.)				
See under <i>Acid, Tartaric</i>				
<i>Potassium bromid</i> . See under <i>Bromin</i> .				
<i>Potassium citrate</i> .				
Diaphoretic and alkaline diuretic.				
Used in pyelitis.....	1-2 gr.	2-5 gr.	5-10 gr.	10 gr.
<i>Potassium chlorate</i> .				
Astringent and antisialogogue.				
Used in stomatitis of every type, in				
tonsillitis, and angina .....	$\frac{1}{2}$ gr.	1 gr.	2-3 gr.	3 gr.
<i>Potassium iodid</i> .				
Antispasmodic and antisymphilitic.....	1 gr.	1-2 gr.	2-3 gr.	3 gr.
<i>Potassium and sodium tartrate</i> . (Rochelle				
salt.) See under <i>Acid, Tartaric</i> .				
PRUNUS VIRGINIANA. See <i>Wild Cherry</i> .				
PUMPKIN SEED. <i>Pepo</i> .				
Teniafuge. Best given in an emulsion;				
average dose, 1 dr.				
QUASSIA.				
<i>Infusion of quassia</i> .				
Vermifuge.				
An extemporaneous infusion is made by				
adding 1 or 2 ounces of quassia chips to a				
pint of water. This is injected high up				
into the bowel.				
Used particularly to destroy <i>Oxyuris</i>				
vermicularis.				
QUININ. (Alkaloid of cinchona.)				
<i>Bisulphate of quinin</i> .....	1 gr.	1-2 gr.	2-3 gr.	3-4 gr.
<i>Sulphate of quinin</i> .....	1 gr.	1-2 gr.	2-3 gr.	3-4 gr.
<i>Tincture of cinchona</i> .....	..	5-10	15 drops	20-30
All these are bitter tonics and anti-		drops		drops
periodics.				
RHAMNUS PURSHIANA. See <i>Cascara Sa-</i>				
<i>grada</i> .				
RHUBARB.				
<i>Powdered rhubarb</i> .				
Laxative.....	1-2 gr.	2-3 gr.	3-4 gr.	5 gr.
<i>Aromatic syrup of rhubarb</i> .				
Laxative and flavoring medium.....	1 dr.	2 dr.	3 dr.	4 dr.
<i>Mixture of rhubarb and soda</i> .				
Corrective and laxative.				
<i>R. Pulveris rhei</i> ,				
<i>Sodii bicarbonatis</i> ..... āā gr. xlvij				
<i>Syrupi rhei aromatici</i> ..... ℥ij				
<i>Aquæ</i> ..... q. s. ad ℥ij				
<i>M. Sig.</i> —One to three doses daily.....	$\frac{1}{2}$ dr.	2 dr.	3 dr.	4 dr.
ROCHELLE SALT. See under <i>Acid, Tartaric</i> .				
SACCHARIN. (Benzosulphinidum.)				
Substitute for sugar, but 200 times				
sweeter.				
For 8 ounces of food, $\frac{1}{2}$ -1 gr. is sufficient.				
SACCHAROSE. See <i>Sugar</i> .				
SALICYLIC ACID. See <i>Acid, Salicylic</i> .				
SALOL. See under <i>Acid, Salicylic</i> .				
SANTONIN. (Anhydrid of santoninic acid.)				
Vermifuge, for round-worms particularly				
SENNA.	$\frac{1}{2}$ gr.	1 gr.	1-2 gr.	2 gr.
Cathartic. Best given as compound				
licorice powder, of which it is an ingre-				
dient ( <i>q. v.</i> ).				

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
SERUM ANTIDIPHtherITICUM. (Diphtheria antitoxin.) For immunization: 2000 to 5000 units. In faucial diphtheria: 5000 to 10,000 units and repeat in eight hours if required. In laryngeal diphtheria: 10,000 units and repeat in eight hours if required. The repetition of the doses of antitoxin is discontinued only when the case ceases to require the serum. The dosage is independent of the age of the patient.				
SODIUM. <i>Sodium benzoate.</i> Antiseptic, antipyretic, and antirheumatic. Used in cystitis with alkaline fermentation to acidify the urine, which it does by the liberation of hippuric acid. ....	1 gr.	1-2 gr.	2 gr.	3 gr.
<i>Sodium bicarbonate.</i> Antacid, antirheumatic. ....	1-2 gr.	2 gr.	3 gr.	5 gr.
<i>Sodium borate.</i> (Borax.) Antiseptic and astringent. Used as a gargle and mouth-wash in stomatitis—1 dr. to 8 oz. of water.				
<i>Sodium bromid.</i> See under <i>Bromin.</i>				
<i>Sodium citrate.</i> See <i>Potassium citrate.</i> Anticoagulant in blood transfusion and infant feeding. Alkaline diuretic. ....	1-2 gr.	2-5 gr.	5-10 gr.	10 gr.
<i>Sodium iodid.</i> (See <i>Potassium iodid.</i> )				
<i>Sodium phosphate.</i> Laxative and cholagogue. ....	5-10 gr.	10-15 gr.	15-20 gr.	20-30 gr.
<i>Sodium sulphate.</i> (Glauber's salt.) Cathartic. Used in intestinal infection of inactive type. ....	15-30 gr.	30-45 gr.	40 gr.—1 dr.	1 dr.
<i>Sodium salicylate.</i> See under <i>Acid, Salicylic.</i>				
SPEARMINT. ( <i>Mentha viridis.</i> ) <i>Water of spearmint.</i> (Aqua menthæ viridis—0.2 per cent. oil of spearmint.) Carminative, sedative, and vehicle. ....	1 dr.	2 dr.	3 dr.	4 dr.
STRONTIUM. <i>Strontium bromid.</i> See under <i>Bromin.</i>				
STROPHANTHUS. <i>Tincture of strophanthus</i> (11 per cent. in New Pharmacopeia, or twice former strength). Cardiac tonic and diuretic. Occasionally preferred to digitalis in the treatment of children because it is possibly better borne. ....	1 drop	1-2 drops	2 drops	2-3 drops
STRYCHNIN. See under <i>Nux Vomica.</i>				
SUGAR. (Cane-sugar or saccharose.) Sweetening agent. May be substituted for lactose in the adaptation of cow's milk for infant feeding. 1 level tablespoonful equals $\frac{1}{2}$ oz. Undergoes alcoholic fermentation.				

DRUG.	DOSE.			
	6 Months.	18 Months.	3 Years.	5 Years.
SUGAR OF MILK. (Lactose.) Used as an excipient and in the adaptation of cow's milk for infant feeding. 1 level tablespoonful equals $\frac{1}{3}$ oz.				
SULPHONAL. Not advised in the treatment of children.				
SULPHUR. <i>Precipitated sulphur</i> , or milk of sulphur. Laxative and alterative. Given usually in syrups or other heavy vehicles. Used also as a reducing agent in bismuth mixtures when the stools do not become dark colored.	5 gr.	5-10 gr.	15-30 gr.	1 dr.
TANNALBIN. See under <i>Acid, Tannic</i> .	1 gr.	1 gr.	1 gr.	1 gr.
TANNIGEN. See under <i>Acid, Tannic</i> .				
TARTAR EMETIC. See under <i>Acid, Tartaric</i> .				
TARTARIC ACID. See <i>Acid, Tartaric</i> .				
TERBENE. Stimulating expectorant and antiseptic	..	1 drop	1-2 drops	2 drops
TERPIN HYDRATE. Expectorant and antiseptic. Used in subacute and chronic bronchitis.	..	..	$\frac{1}{4}$ gr.	$\frac{1}{2}$ gr.
TRIONAL. Not advised in the treatment of children.				
UROTROPIN. (Trade name for hexamethylenamin.) Urinary antiseptic in acid medium	$\frac{1}{2}$ gr.	1 gr.	1-2 gr.	2-5 gr.
WHISKY. See under <i>Alcohol</i> .				
WILD CHERRY. <i>Syrup of wild cherry</i> . (Syrupus pruni virginiani.) Bronchial sedative and vehicle. Contains hydrocyanic acid.	..	..	$\frac{1}{2}$ dr.	1 dr.

### DRUGS FOR EXTERNAL USE

- ACID, BORIC.  
Antiseptic of mild grade. 4% is a saturated solution.  
Used both in solution and in ointments.  
In the form of scales it is most soluble and most convenient.
- ACID, CARBOLIC. See *Phenol*.
- ACID, CHROMIC. (Chromic Trioxid.)  
A very strong caustic and astringent, used as a substitute for Nitrate of Silver.
- ACID, NITRIC (68% pure acid).  
Used as a caustic.
- ACID, SALICYLIC.  
Used in lotions or in ointments, 1 to 3% for skin affections.
- ACID, TANNIC.  
Astringent.  
Used in 1% solution in dysentery; as an ingredient of suppositories for hemorrhoids. See also *Glycerite of Tannin* under *Glycerin*.
- ADRENALIN. (Trade name for *Epinephrin*, the active principle of the Adrenal Gland.)  
Used in a solution in the strength of 1 part to 1000 of normal saline solution or sterilized oil.  
Local hemostatic and astringent. It will render bloodless the field of operation of the eye, nose, and throat, but its use is often followed by hemorrhage.

## ALUMINIUM ACETATE, Solution of.

Antiseptic dressing for cellulitis, abscesses, etc.

- |    |   |                          |           |
|----|---|--------------------------|-----------|
| 1. | R | Aluminii sulphatis ..... | 3 iiii ss |
|    |   | Acidi aceticici .....    | 5 iv ss   |
|    |   | Aquæ .....               | 5 x       |
| 2. | R | Calcii carbonatis .....  | 5 iss     |
|    |   | Aquæ .....               | 5 iiii ss |
- Add 1 to 2, stirring.

AMYLUM. See *Starch*.ARGENTUM. See *Silver*.ARGYROL. See *Silver*.

ARISTOL. (Thymol Di-iodid.)

Mild antiseptic, used as a dusting-powder or in ointments.

BALSAM OF PERU.

A stimulating dressing for wounds and ulcers.

In Castor Oil, one part of the Balsam to six of the oil. It makes a useful application for burns and wounds.

BENZOIN.

*Compound Tincture of Benzoin.*

Used as a bronchial sedative in steam inhalations, 1 teaspoonful to one pint of water.

BICHLORID OF MERCURY. See under *Mercury*.

BISMUTH SUBGALLATE. (Dermatol.)

Used externally as a drying antiseptic powder, either pure or in combination.

Also as an ingredient of ointments of 10 to 20% strength.

BORACIC ACID. See *Acid, Boric*.

CACAO-BUTTER. (Oleum Theobromatis.)

A fixed oil expressed from the seeds of the *Theobroma Cacao*. Melts at 30°–35° C. (86°–95° F.).

Used as an emollient and as a base for suppositories. It may be used for nutrient inunction, but it is less effective than Goose Oil.

CALAMINE. (Zinc Carbonate.)

Used as an ingredient of soothing lotions in itching affections of the skin—eczema, urticaria, dermatitis venenata, etc.

CALOMEL. See under *Mercury*.

CANTHARIDES.

Vesicant. Used best in the form of Collodion of Cantharides, *q. v.*

CARRON OIL. (Linimentum Calcis.)

Consists of equal parts of Lime-water and Linseed Oil.

Used as a soothing application for burns and scalds.

CHLOROFORM.

Locally a rubefacient and, when confined, a vesicant as well. A useful ingredient of liniments.

By inhalation, a general anesthetic (p. 869).

CHRYSAROBIN.

Used in 5% ointment for psoriasis and tinea tonsurans.

COCAIN. See *Eucaïn* (below) and *Novocain* (p. 878).Alkaloid obtained from several varieties of *Coca*.

A local anesthetic when applied to wounds or mucous surfaces or when injected hypodermically.

For local application, 3 to 10% solutions.

For hypodermic use, 0.2 to 2% solutions.

COD-LIVER OIL.

May be used locally as a nutrient inunction, but its odor is objectionable.

COLLODION.

Solution of Pyroxylin in Alcohol and Ether.

Collodion of Cantharides (60% Cantharides). An excellent blistering agent.

Collodion of Ichthyol (10–20%). Used to cover the wound after aspirations or lumbar punctures and in checking the spread of erysipelas.

Collodion of Iodoform (5%). Used in erysipelas.

Collodion of Oil of Cade (1–5%). Used in eczema.

Collodion of Salicylic Acid (10%). Used in removing corns and calluses.

CREOSOTE.

Used in inhalations as a pulmonary antiseptic.

DERMATOL. See *Bismuth Subgallate*.

EUCAIN.

Beta-eucaïn. Local anesthetic with action and uses similar to those of Cocain, but without its toxicity. Solutions can be sterilized without injury by boiling.

**FORMALDEHYD.**

Antiseptic and deodorant.

Used in solutions of from 0.5 to 2% strength, as an antiseptic.

Used in the form of the gas for disinfecting, the gas being generated by heat, from solutions, or from the solid, Paraform.

**GLYCERIN.**

Used chiefly as a solvent or excipient. Very hygroscopic. It is the base of the Glycerites.

*Glycerite of Carbolic Acid*—20% phenol in glycerin. An external antiseptic and antipruritic.

*Glycerite of Starch*—10%. A vehicle for skin preparations and for pills.

**GOOSE OIL.**

The oil tried from the goose. An excellent oil for cutaneous inunction. It is better than Olive Oil or Cacao-butter, for, being an animal oil, it is more readily absorbed by the skin. It is semifluid, has a low melting-point, and does not become hard after having been rubbed in.

**GRINDELIA ROBUSTA.**

The fluidextract, in the strength of one dram to a pint of water, is used as a wet dressing in dermatitis venenata.

**GUAIACOL.**

Combined with equal parts of Glycerin, it is used in acute joint affections, for its analgesic effect.

**HAMAMELIS.** See *Witch-hazel*.**HYDRARGYRUM.** See *Mercury*.**HYDROGEN PEROXID.**

Antiseptic and deodorizer. Used in 10-volume, 3% solution to clean wounds, and to dissolve and destroy pus.

**ICHTHYOL.**

Used in 1% solution in intertrigo.

Used in 10 to 50% ointments to lessen glandular or joint swellings.

Used in 5 to 50% ointments in skin diseases or in erysipelas.

Used suspended in oil in strength of 5 to 25% as a nasal spray.

**IODIN.**

*Tincture of Iodin* (7%).

Antiseptic and counterirritant.

Used particularly in tinea tonsurans and tinea circinata.

**ODOFORM.** Formyl Tri-iodid.

Antiseptic and alterative.

Used in the form of a powder, an ointment, or in gauze in the strength of 5 to 10%.

**KAOLIN.**

Cataplasma Kaolini.

A smooth, homogeneous mass, consisting of Kaolin, Boric Acid, Thymol, Methyl Salicylate, Oil of Peppermint, and Glycerin.

**LANOLIN.**

Used as an ointment base.

**LEAD AND OPIUM WASH.**

Anodyne lotion.

R. Liquoris plumbi subacetatis.....	℥iv
Tincturæ opii.....	℥j
Aquæ.....	℥xvj
Fiat mistura.	

Sig.—Use externally.

**MENTHOL.** (Peppermint Camphor.)

Sedative, analgesic, refrigerant, and antipruritic.

Used in ointments, 1 to 5%.

Used in oily solutions, 1 to 5%.

Used triturated with equal parts of Camphor as an anodyne.

**MERCURY.**

*Bichlorid of Mercury*.

Antiseptic. Used in 1 : 1000 to 1 : 20,000 solutions.

*Calomel*.

A milder antiseptic than the foregoing. Used as a dusting-powder in eye affections and on the lesions of secondary syphilis.

*Mercury and ammonium chlorid.* (White precipitate.)

Used in ointments of 1 to 10% strength as an antiparasitic and antisymphilitic. Of particular value in impetigo contagiosa, ringworm, etc.

*Yellow oxid of mercury.*

Antiseptic. Used in ointments of 0.5 to 1% strength in ophthalmia. Of value also in ringworm and syphilitic eruptions.

**MUSTARD.**

Counterirritant.

In the form of papers (*chartæ*) for local pain or vomiting.

In the form of powder:

In pastes of a strength of 1 part of mustard to from 2 to 6 parts of flour.

In baths—1 tablespoonful to 6 gallons of water.

In packs, in the same proportion.

**OIL OF CADE.** (Oil of Juniper Tar.)

Used as an antiparasitic in skin diseases.

In powders, 1 to 5% in a base of stearate of zinc.

In ointments, 1 to 5%.

In collodion, 1 to 5%.

**OIL OF TURPENTINE.** (Spirits of turpentine.)

Rubefacient and counterirritant.

Used as an ingredient of liniments.

Used in the form of turpentine stupes for the relief of abdominal distention.

Flannel cloths are wrung out in hot water to each pint of which 10 to 20 drops of oil of turpentine have been added, and are then applied to the abdomen.

**OLIVE OIL.**

Used externally as a nutrient inunction.

**PETROLATUM** (Petroleum Jelly or "Vaseline").

Used as a base for ointments.

**PHENOL.** (Pharmacopœial name of Carbolic Acid.)

Local anesthetic and antiseptic.

Used as an antiseptic in solutions of the strength of 5% or less.

Used as a caustic and local anesthetic in strength of 95%.

Children are very susceptible to phenol poisoning.

**PIX LIQUIDA.** See *Tar*.**POTASSIUM PERMANGANATE.**

Antiseptic and disinfectant.

Used in solutions in the strength of 1 : 4000 to 1 : 2000 on mucous surfaces and in the strength of 1 : 1000 on ulcers and superficial wounds.

**RESORCIN.**

Antiseptic in skin diseases, particularly in seborrheic eczema.

Lotions, 1 to 5%.

Ointments, 1 to 5%.

**SILVER.**

*Silver Nitrate.* Antiseptic and astringent. Used in solutions of 1 to 50% strength.

As a caustic it is used in the solid form.

*Argyrol.* (Silver Vitellin—Proprietary.)

A mild antiseptic, not approaching the nitrate in efficacy. Used in solutions of 5 to 50% strength or in ointments of 5 to 50% strength.

**SODIUM BICARBONATE.**

Used in saturated solution as an antipruritic and as an analgesic in skin diseases and burns.

**STARCH.**

Used as the base of drying powders.

**SULPHUR.**

In 5 to 25% ointments as a parasiticide, particularly in scabies.

**TAR.** (*Pix Liquida.*)

Antiseptic. Used in skin diseases as the official ointment (50%) or in ointments with other ingredients.

**ZINC OXID.**

Used as a 20% ointment in benzoinated lard in skin diseases, such as eczema, needing a mild astringent.

Used in dusting-powders in the strength of 5 to 10%.

Official zinc ointment makes a good base for stronger antiseptics, such as tar and oil of cade.



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